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MEM#1

ChemRisk/Shonka Research Associates, Inc., Document Request Form

(This section to be completed by subcontractor requesting document)

J. Lamb / K-25 CEP

Requestor / Document Center (is requested to provide the following document)

Date of request 4/28/95 Expected receipt of document 5/20/95

Document number None Date of document ~~12/24~~ 12/7/93

Title and author (if document is unnumbered)

Feasibility Assessment: Treatment and Disposal of PCB Transformers at K-25 (Interim Final)

(This section to be completed by Document Center)

Date request received 4/28/95

Date submitted to ADC 5/5/95

Date submitted to HSA Coordinator 5/10/95

(This section to be completed by HSA Coordinator)

Date submitted to CICO 5/16/95

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Date submitted to ChemRisk/Shonka and DOE 5-22-95

This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received

Signature

ChemRisk Document No. 1871

I N T E R O F F I C E   M E M O R A N D U M

Date: 21-Dec-1993 03:42pm EST
From: Ricky Joe Keeling
KEELINGRJ
Dept: 6125
Tel No: (615)576-3968

TO: See Below

Subject: Comments on Draft Report on PCB Transfomer Options
File: OUTBOX 008263

Distribution:

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This document has been reviewed for classification and has been determined to be UNCLASSIFIED.
Sara H. Welch
ADC Signature
5/10/95
Date

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

This document has been approved for release to the public by:
[signature]
Technical Information Officer
Oak Ridge K-25 Site
5/18/95
Date

December 21, 1993

To: Steve Nolan

cc: Mike Mitchell
Doug Goins
Gary Person

Subject: **Comments on Draft Report on PCB Transformer Options**

Per your request to Mike Mitchell of December 8, the attached comments are submitted on Mr. Mitchell's behalf. Please contact me at 576-3968 if you have any questions or need further clarification.

Ricky J. Keeling

General Comments:

1. The assessment does not appear to clearly and concisely address the three alternatives identified for evaluation in the executive summary. The report expands too much on commercial vendor service capabilities and not on the evaluation of three treatment and disposal alternatives for transformers. It is recommended that the report be rewritten in a way which clearly identifies the objectives for the report and then clearly focus on addressing the objectives.

2. Potential commercial vendor options can be identified by use of the EPA-TSCA listing of EPA Approvals for disposal of PCBs. This listing can be obtained through the TSCA Hotline (202/554-1404) or the Chemical Regulation Reporter.

3. Please add statements which identify that the vendors reviewed does not represent an endorsement of vendors or represent all vendors available.

4. Please note that this is only a "snapshot in time" of some the of available vendor options. New vendors and capabilities are continuing to be identified and considered for possible use.

page vii:

5. To avoid confusion with other compliance agreements identify the subject agreement as the UE **TSCA** FFCA.

page 3-2

6. Delete section 3.1.2. Conversion(?), decontamination of containers, and reclassification does no fit as options for transformers removed from service and drained.

7. 3.1.3: Strike the statement, "If the PCB wastes will be disposed within 10 days, the generator needs only to comply with DOT regulations."

page 6-1

8. Table 6.1 "Vendor Capabilities", could be misleading since the table does not address all vendor's capabilities. Vendors such as Rollins and U. S. Ecology are not included.

page 6-3

9. Do not use the term "Unregulated" in "Unregulated Transformer Processing". Material Recovery is not required to have a EPA-TSCA approval. The PCB material processed is still regulated for proper disposal and future use. (Reference letter previously provided by EPA dated 9/6/86 Moore to Allen).

page 6-5

10. The statement, "This process does not handle transformers with 500 ppm or greater PCB", conflicts with the information provided by Aptus on previous site visits. From memory we have to used Aptus to drain and flush PCB Transformers for and send the carcasses to the U. S. Ecology Chemical Waste Landfill in Beatty, Nevada.

page 9-1

11. In recommendation 2-b, add "in accordance with 40 CFR 761 and...."

RJK December 21, 1993
PEC: VIII.B.1.b.5.
b:PCBTRANS.K25

To: ✓Mike Mitchell
Doug Goins
cc: Gary Person
From: Steve Nolan
Date: December 8, 1993
Subject: Draft Report on PCB Transformer Options

Keeling
Please handle for me
MEW

DEC 8 1993

12/13/93

Attached is a final draft version of an assessment on the disposal of PCB and PCB-contaminated transformers at the K-25 Site. Approximately six months ago, the D & D program asked Engineering to do a technical evaluation on the different options for disposal of the K-25 transformer. The purpose was to have people who were technically competent, but not closely involved with the D&D effort to take a fresh look at the problem of trying to dispose of the PCB transformers in light of the offsite shipment moratorium. The intent was not to use the study to determine the final course of action but to help assist us in making this decision in the future and is to be used as a tool for us to use. Engineering in turn has used PAI Corporation to do the actual writing of the report. Individuals from both Engineering and PAI worked together in putting this report together.

Drafts have been reviewed by a number of people including representatives of the D&D Program, K-25 Waste Management, and K-25 and Central Environmental Management. The audience for this report was primarily for D&D although if other organizations wanted to look at the report we would make it available to them.

As discussed with you earlier, we are not aware that any sections of this report conflicts with ESS-EP-125 or with any other previous communications with DOE. However before finalizing this report, we would like you to review and comment to make sure this is consistent with the positions that Central Environmental and the legal staff has taken, especially in regards to the radioactivity issues.

I would like to receive any of your comments back no later than December 17 in order to complete the report by the end of the year.

I appreciate your help with this.

Steve Nolan

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

- DRAFT -

FEASIBILITY ASSESSMENT: TREATMENT AND DISPOSAL OF PCB TRANSFORMERS AT K-25 (INTERIM FINAL)

December 7, 1993

Prepared by

PAI Corporation
116 Milan Way
Oak Ridge, Tennessee 37830
under
Subcontract No. 90K-VE450C

for

MARTIN MARIETTA ENERGY SYSTEMS
Oak Ridge, Tennessee

This document has been approved for release to the public by:

Technical Information Officer 5/18/95 Date
Oak Ridge K-25 Site

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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under Contract DE-AC05-84OR21400

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
BRC	below regulatory concern
CDR	conceptual design report
CFR	*Code of Federal Regulations*
CP	cathodic-protection transformer
cm^2	square centimeter
CSR	*Code of State Regulations*
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
EA	environmental assessment
EIS	environmental impact statement
EM-30	DOE Office of Environmental Restoration and Waste Management Office of Waste Operations
Energy Systems	Martin Marietta Energy Systems, Inc.
ENSCO	Environmental Systems Company
EPA	U.S. Environmental Protection Agency
EPS	Environmental Protection Services, Inc.
h	hour
K-25	Oak Ridge K-25 Site (formerly Oak Ridge Gaseous Diffusion Plant)
KUB	Knoxville Utilities Board
kV	kilovolt
μCi	microcurie
μg	microgram
mrad	millirad
mrem/h	millirem per hour
NA	Not Applicable
NEPA	National Environmental Policy Act of 1969
NRC	U. S. Nuclear Regulatory Commission
OCB	oil circuit breaker
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyl
PM	program manager

ACRONYMS AND ABBREVIATIONS (continued)

ppm	parts per million
QA	quality assurance
RCRA	Resource Conservation and Recovery Act of 1976
RMMA	radioactive materials management area
RMSA	radioactive materials storage area
RRCA	regulated radiological controlled area
s	second
S&A	sampling and analysis
SDMI	S. D. Myers, Inc.
SEG	Scientific Ecology Group
SPMO-QAP	Site Project Management Organization Quality Assurance Program
TSCA	Toxic Substances Control Act of 1976
TSD	treatment, storage, and disposal
TVA	Tennessee Valley Authority
UE-FFCA	Uranium Enrichment Federal Facilities Compliance Agreement

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) K-25 Site (K-25) currently stores approximately 200 inactive transformers awaiting disposal. All of these transformers have been drained of their dielectric fluids, much of which contained varying levels of polychlorinated biphenyls (PCBs). Timely disposal of these units is mandated by both the Toxic Substances Control Act (TSCA) and the Uranium Enrichment Federal Facilities Compliance Agreement; however, Martin Marietta Energy Systems (Energy Systems) has raised concerns about the possibility of existing radioactive contamination of the units. DOE's current policy is to not ship radioactively contaminated wastes off site unless they meet the concentration guidelines in DOE Order 5400.5 and in the DOE Office of Environmental Restoration and Waste Management Office of Waste Operations (EM-30) *Performance Objective for Certification of Nonradioactive Hazardous Waste* (i.e., the Objective, or ref. 1) also known as the "no rad added" policy.

The Objective's goal is to assure that hazardous/toxic waste shipped from DOE facilities to commercial treatment, storage, or disposal facilities has no radioactive contamination added as a result of DOE operations. The exception is when the receiving facility is specifically licensed to manage radioactive waste. The Objective, in the absence of a federally established *de minimis* level, serves as interim guidance pending the establishment of risk-based numerical limits for the release of waste believed to have an insignificant impact upon public health and the environment.

Energy Systems' Site Programs Organization requested a feasibility assessment to address the following three treatment and disposal alternatives for the transformers:

1. certification that the transformers are not radioactive waste, followed by shipment to a commercial vendor for treatment and disposal/recycling;

2. shipment of the transformers as PCB/radioactive waste to a commercial vendor that is fully licensed to treat, dispose, or recycle such wastes; and

3. on-site treatment of the transformers to remove the PCB and/or the radioactive contamination (if necessary), followed by shipment to a commercial vendor for further treatment, disposal, and/or recycling, provided the appropriate concurrences are received from the states where the transformers are to be treated, disposed, and recycled.

The project involved researching applicable guidelines and regulations, and identifying and visiting four vendors with potential capabilities to address the needs of the project.

Key conclusions of the study are:

1. Both logistics and economics indicate that Alternative #1 is the most desirable.

2. The primary obstacle to the implementation of Alternative #1 is the Objective set forth by DOE in late 1991. No other regulation or guideline appears to pose any significant problems.

3. After sampling (and simple decontamination of some units as necessary), most of the subject transformers are expected to meet the Objective, provided the appropriate concurrences are received from the states where the transformers are to be treated, disposed, and recycled.

This feasibility assessment recommends that, subject to appropriate sampling and on-site decontamination (as necessary to support off-site release), most or all of the transformers could be certified as nonradioactive, followed by shipment to one or more commercial facilities for treatment, disposal, and recycling.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) K-25 Site (K-25), operated by Martin Marietta Energy Systems, Inc. (Energy Systems), houses approximately 200 (1.4 million lb) inactive transformers currently awaiting disposal, including many formerly filled with fluids containing polychlorinated biphenyls (PCBs). Because of the potential of serious health effects from exposure to PCBs, the Toxic Substances Control Act (TSCA) regulates the use and disposal of PCB-containing articles, including many of the transformers at K-25. TSCA's restrictions on the use and disposal of fluids containing PCBs and equipment containing PCBs vary depending upon the concentration of the PCBs. In addition, DOE and the U.S. Environmental Protection Agency (EPA) have entered into a Uranium Enrichment Federal Facility Compliance Agreement (UE-FFCA) that further regulates the management of the transformers.

Originally, Energy Systems planned to dispose of the transformers by shipment to a commercial vendor specializing in the decommissioning of such units. As part of the intended disposal process, the transformers were drained of fluid. Before the units could be removed from K-25, both Energy Systems and DOE experienced problems with off-site shipments of certain wastes containing measurable levels of radioactivity. This resulted in a DOE-imposed "moratorium" on further off-site waste shipments. Interim guidance was then issued by the DOE Office of Environmental Restoration and Waste Management - Office of Waste Operations (EM-30) entitled *Performance Objective for Certification of Nonradioactive Hazardous Waste* (ref. 1), referred to in this document as the Objective. Through a conservative interpretation of the Objective, Energy Systems considers the transformers as potentially PCB/radioactive waste, presenting difficulties in both releasing the units and finding a commercial facility willing to accept them. This assessment assumes that the moratorium, to the extent that it is absolute, will have been at least partially lifted by the time this project is implemented. Such lifting will still require that the guidelines of the Objective (and other relevant regulations, orders, and agreements) be strictly followed.

This study addresses the advantages of and constraints upon three possible scenarios for the disposal of the transformers:

1. certification by Energy Systems that some or all of the transformers are not radioactive waste, followed by shipment to a commercial transformer treatment and/or disposal facility;

2. determination or assumption that some or all of the transformers are PCB/radioactive waste, followed by shipment to a facility able to accommodate both the PCB and radioactive contamination; and

3. determination or assumption that some or all of the transformers are PCB/radioactive waste, followed by on-site treatment to remove both the PCB and radioactive constituents, followed by shipment to a disposal/recycling facility.

As part of the study, four commercial facilities that treat and dispose of equipment contaminated with PCBs were visited to evaluate their capabilities and methodology for the decommissioning and disposal of transformers:

1. Environmental Protection Services, Inc. (EPS) of Wheeling, West Virginia, treats transformers having less than 500 ppm PCB by total-unit incineration and secondary combustion of the off-gas. All components are recycled, including the resulting ash. No material goes to landfills.

2. S. D. Myers, Inc. (SDMI) of Tallmadge, Ohio, treats transformers by disassembly, solvent wash, and recycling constituents. Combustibles are shipped to a remote incinerator. Only ash may go to landfills and all components are segregated.

3. UNISON, Inc., of Ashtabula, Ohio, treats transformers by disassembly and solvent wash. All metal and ceramic components are recycled; the combustibles and fluids are shipped to an off-site incinerator. Only ash may go to landfills.

4. Aptus, Inc., of Coffeyville, Kansas, treats transformers by disassembly and solvent wash, with all metal and ceramic components recycled. The combustibles are incinerated in an on-site Resource Conservation and Recovery Act (RCRA)/TSCA-permitted facility. Some transformer components cannot be disassembled and are solvent washed prior to shipment to a landfill. Ash is landfilled.

The study concludes by assessing the technical and regulatory feasibility of each of the three broad alternatives for disposal: off-site disposal as PCB waste; off-site disposal as PCB/radioactive waste; and on-site treatment as PCB/radioactive waste, followed by off-site disposal/recycle as nonradioactive, non-PCB waste. Due to the stringent criteria (imposed by state permit) for acceptance of PCB waste in on-site landfills, and space limitations in the landfills, this option is not considered viable by Energy Systems at this time. The study also assesses the applicability of the technologies used by the four vendors with respect to these alternatives.

Section 2 presents a physical description of the transformers and fluids and summarizes the three general alternatives. Section 3 provides the regulatory and administrative justification for the disposal of the transformers. Section 4 briefly considers the remaining uncertainties, the most critical being the interpretation of the Objective. Section 5 addresses policy constraints on the projects, beyond the regulations, etc., discussed in Section 3. Section 6 assesses vendor capabilities to deal with transformers in general and with the potentially PCB/radioactive transformers at K-25. Section 7 evaluates the alternatives in light of technical feasibility, cost, and schedule. Section 8 provides preliminary assessments of project risk and other elements. Finally, Section 9 provides the recommendations of the feasibility assessment. References are provided in Section 10.

2.0 PHYSICAL DESCRIPTION

2.1 PROJECT OVERVIEW

2.1.1 Equipment Involved

The transformers involved (***Tables 2.1*** and *2.2*) range in size from 35 ft^3 to 8,400 ft^3, in weight from 2,000 lb to 328,000 lb, and in PCB concentration from 51 ppm to 996,130 ppm. Transformer locations are given in these tables. All liquids have been drained from the out-of-service transformers on site although some residual liquids may exist. Twenty-four transformers will be moved to a special vault because they previously contained mineral oil with PCB concentrations in excess of 500 ppm. All large, cumbersome transformers have been stored and diked in preparation for shipment. Other than the transformers that have been moved to Regulated Radiological Controlled Area (RRCA) vaults, transformers have not been moved from their original locations.

The three transformers outside K-709 are 161-kV to 13.8-kV regulating transformers. All of the transformers in this area contained mineral oil with PCB concentrations less than or equal to 126 ppm. They are now located in the K-25 Switchyard, which is across the street from an outdoor radiological area.

The four transformers outside K-762 are bus-potential transformers. All of these transformers contained mineral oil with PCB concentrations less than or equal to 59 ppm. They are now located in the K-31 Switchyard, which is adjacent to a non-radiological facility.

Of the 49 transformers in K-792:

- three are 161-kV oil circuit breakers (OCBs),
- fourteen are 13.8-kV grounding reactors,
- fourteen are 13.8-kV grounding transformers,
- twelve are bus-potential transformers,
- five are current transformers, and
- one is a 161-kV-to-13.8-kV power transformer.

Only 9 of the 49 transformers from this location contained mineral oil with PCB concentrations in excess of 500 ppm. These nine transformers are now located in the K-33 Switchyard, which is adjacent to a non-radiological facility.

Transformers vaults are used to store 34 cathodic-protection transformers; 29 of these are in K-25, and the remaining 5 are in K-27. Only six of these contained mineral oil with PCB concentrations in excess of 500 ppm. All 34 are located in a contaminated facility. According to Energy Systems' *Radiological Control Manual* (K/HS-410) (ref. 2), a contamination area has contamination levels greater than the values as reproduced in ***Table 3.1*** of this assessment (p. 3-6), but less than or equal to 100 times these levels. Also, the area surrounding the vaults is considered an outdoor radiological area.

At K-633, the Gaseous Diffusion Test Loop Facility, one power transformer contained mineral oils with a PCB concentration of 83 ppm. K-633 is designated a contaminated facility, is adjacent to an outdoor radiological area, and is in shutdown mode.

Table 2.1. Inventory of Mineral-Oil Electrical Equipment

Serial No.	Type of Equipment	PCB (ppm)	Weight (lb)	Dimensions	Location
B200680	Reg. Tr.	92	40,500	11 ft × 13 ft × 15 ft	K-709
B200681	Reg. Tr.	92	40,500	11 ft × 13 ft × 15 ft	K-709
7568224	Reg. Tr.	126	40,500	11 ft × 13 ft × 15 ft	K-709
5125524	Pot. Tr.	59	5,900	5 ft × 5 ft × 14 ft	K-762
5125525	Pot. Tr.	54	5,900	5 ft × 5 ft × 14 ft	K-762
5125520	Pot. Tr.	55	5,900	5 ft × 5 ft × 14 ft	K-762
5125522	Pot. Tr.	51	5,900	5 ft × 5 ft × 14 ft	K-762
B686482	Cur. Tr.	67	2,000	2.5 ft × 2.5 ft × 9 ft	K-792
B686476	Cur. Tr.	214	2,000	2.5 ft × 2.5 ft × 9 ft	K-792
B686477	Cur. Tr.	194	2,000	2.5 ft × 2.5 ft × 9 ft	K-792
B686484	Cur. Tr.	61	2,000	2.5 ft × 2.5 ft × 9 ft	K-792
B686480	Cur. Tr.	62	2,000	2.5 ft × 2.5 ft × 9 ft	K-792
6566201AM513	OCB	257	43,000	7.5 ft × 25 ft × 12 ft	K-792
6466201AM519	OCB	156	43,000	7.5 ft × 25 ft × 12 ft	K-792
6566201AM507	OCB	195	43,000	7.5 ft × 25 ft × 12 ft	K-792
B686498	Gnd. Rx.	57	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686496	Gnd. Rx.	57	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686500	Gnd. Rx.	96	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686497	Gnd. Rx.	86	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686499	Gnd. Rx.	88	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686495	Gnd. Rx.	81	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686491	Gnd. Rx.	138	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686494	Gnd. Rx.	102	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686490	Gnd. Rx.	607	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686489	Gnd. Rx.	612	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686492	Gnd. Rx.	178	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686488	Gnd. Rx.	1190	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686487	Gnd. Rx.	1360	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686493	Gnd. Rx.	163	2,000	3.5 ft × 3.5 ft × 9 ft	K-792
B686510	Gnd. Tr.	57	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686507	Gnd. Tr.	332	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686512	Gnd. Tr.	58	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686508	Gnd. Tr.	135	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686513	Gnd. Tr.	92	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686509	Gnd. Tr.	79	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686511	Gnd. Tr.	56	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686505	Gnd. Tr.	134	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686506	Gnd. Tr.	165	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686503	Gnd. Tr.	448	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686504	Gnd. Tr.	328	8,000	5 ft × 6.5 ft × 9 ft	K-792

Source: This information was obtained from Energy Systems Specification 16065, Attachment A (K-25 Site), provided by Clyde Pedigo, June 24, 1993.

Table 2.1. **Inventory of Mineral-Oil Electrical Equipment** (continued)

Serial No.	Type of Equipment	PCB (ppm)	Weight (lb)	Dimensions	Location
B686501	Gnd. Tr.	137	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686502	Gnd. Tr.	139	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686514	Gnd. Tr.	91	8,000	5 ft × 6.5 ft × 9 ft	K-792
B686464	Pot. Tr.	105	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686465	Pot. Tr.	302	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686466	Pot. Tr.	404	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686467	Pot. Tr.	126	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686468	Pot. Tr.	127	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686463	Pot. Tr.	132	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686474	Pot. Tr.	402	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686470	Pot. Tr.	1700	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686469	Pot. Tr.	746	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686473	Pot. Tr.	747	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686471	Pot. Tr.	631	6,000	3.5 ft × 4 ft × 14 ft	K-792
B686472	Pot. Tr.	648	6,000	3.5 ft × 4 ft × 14 ft	K-792
5014001371	Pwr. Tr.	87	328,000	20 ft × 14 ft × 30 ft	K-792
7351942	CP	649	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351944	CP	665	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352001	CP	441	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352024	CP	438	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351986	CP	506	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352013	CP	418	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7565793	CP	436	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351940	CP	498	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351943	CP	618	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351945	CP	483	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351941	CP	491	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351960	CP	270	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351962	CP	644	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351946	CP	535	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352028	CP	462	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351990	CP	407	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352020	CP	419	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352017	CP	422	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352023	CP	407	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352025	CP	450	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352030	CP	473	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352008	CP	454	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351999	CP	431	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352015	CP	458	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352019	CP	432	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA

Table 2.1. Inventory of Mineral-Oil Electrical Equipment (continued)

Serial No.	Type of Equipment	PCB (ppm)	Weight (lb)	Dimensions	Location
7352018	CP	456	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7565792	CP	350	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352006	CP	360	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7352004	CP	360	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-25 RRCA
7351961	CP	194	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-27 RRCA
7351969	CP	318	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-27 RRCA
7351957	CP	292	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-27 RRCA
7351952	CP	293	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-27 RRCA
7352036	CP	83	4,000	3.5 ft × 3.5 ft × 6.5 ft	K-27 RRCA
C857111	Pwr. Tr.	83	20,000	8 ft × 8 ft × 12 ft	K-633
37765	Lgt. Tr.	99	6,300	5.5 ft × 6.5 ft × 7.5 ft	K-704
6800043	Aux. Tr.	56	42,500	11 ft × 17 ft × 16.5 ft	K-707
7235502	Pwr. Tr.	713	11,500	6 ft × 8 ft × 10 ft	K-726 RRCA
C699260	Lgt. Tr.	129	3,000	3 ft dia. × 5 ft	K-892
7367536	Pwr. Tr.	1360	11,500	6 ft × 8 ft × 10 ft	K-1037D
NA0000001	Pwr. Tr.	836	11,500	6 ft × 8 ft × 10 ft	K-1037D
NA0000002	Pwr. Tr.	883	11,500	6 ft × 8 ft × 10 ft	K-1037D
NA0000003	Pwr. Tr.	2260	11,500	6 ft × 8 ft × 10 ft	K-1131
7226788	Pwr. Tr.	2230	11,500	6 ft × 8 ft × 10 ft	K-1131
26981	Pwr. Tr.	51	20,000	6 ft × 12 ft × 11 ft	K-1131
7385557	Pwr. Tr.	718	11,500	5 ft × 10 ft × 8.5 ft	K-1301
7226790	Pwr. Tr.	2040	11,500	6 ft × 8 ft × 10 ft	K-862
7367530	Pwr. Tr.	1490	11,500	6 ft × 8 ft × 10 ft	K-862

Legend:

Aux. Tr.	Auxiliary Transformer
CP	Cathodic-Protection Transformer
Cur. Tr.	Current Transformer
Gnd. Rx.	Grounding Reactor
Gnd. Tr.	Grounding Transformer

Table 2.2. Inventory of Askarel Transformers

Serial No.	PCB (ppm)	Weight (lb)	Dimensions	Location
B983100	600030	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983106	631080	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983148	836760	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983101	632380	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983110	481390	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983112	681720	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983107	639560	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159533	620390	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983116	712990	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983109	836055	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159552	806400	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159537	626780	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983113	807630	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983115	664760	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159532	692840	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983166	589180	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983119	766970	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983117	494820	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159541	839400	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983108	591830	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
RIE0225	853360	37,740	11 ft 6 in. × 7 ft 10 in. × 11 ft 5 in.	K-33
RID0174	714410	37,740	11 ft 6 in. × 7 ft 10 in. × 11 ft 5 in.	K-33
RIE0210	679730	37,740	11 ft 6 in. × 7 ft 10 in. × 11 ft 5 in.	K-33
B983209	737710	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983236	907400	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159543	606990	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
159553	658480	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159544	730650	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159559	840310	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159536	669170	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159538	762370	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159545	538080	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159548	601325	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983154	587450	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983105	677010	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159554	565350	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159540	700600	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159556	640470	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159551	660300	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983165	655780	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159535	716360	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159550	831540	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33

Source: This information was obtained from Energy Systems Specification 16065, Attachment A (K-33 Building), provided by Clyde Pedigo, October 1, 1993.

Table 2.2. Inventory of Askarel Transformers (continued)

Serial No.	PCB (ppm)	Weight (lb)	Dimensions	Location
C159557	483160	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983149	637160	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159534	667850	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159547	527980	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159539	473910	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983150	618190	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983151	622310	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983164	622660	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983155	660460	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983147	652040	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983152	568540	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983157	664660	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
C159558	578020	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983153	682210	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983156	637120	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983131	603680	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159520	637100	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983128	629690	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159522	637410	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159527	541970	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159526	562230	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983132	618325	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983134	664030	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159525	604650	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159521	614750	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
NA0000213	645290	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983135	730070	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983129	598960	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983136	606550	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159524	602810	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159529	744050	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159531	637760	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159528	596860	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159530	709510	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
C159523	614190	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983171	767850	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983143	867370	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
B983146	692870	35,850	15 ft 6 in. × 11 ft 7 in. × 11 ft 6 in.	K-33
OLD912A	657240	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
OLD912B	668930	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
OLD914A	745055	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
OLD914B	762980	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33

Table 2.2. Inventory of Askarel Transformers (continued)

Serial No.	PCB (ppm)	Weight (lb)	Dimensions	Location
OLD911A	737560	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
OLD911B	764050	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983133	663050	34,450	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983198[a]	448610	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
KP-0092[a]	787800	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983196[a]	857590	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B981118[a]	919430	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
OLD969A[a]	933145	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
B983124[a]	694000	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
KP-0098[a]	996130	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33
NA0000227[a]	830080	20,000	18 ft 2 in. × 6 ft 4 in. × 11 ft 6 in.	K-33

[a]The internal components of these eight transformers have been removed.

Outside K-704, Stores Storage, one lighting transformer contained mineral oil with a PCB concentration of 99 ppm. K-704 is designated a Radioactive Materials Storage Area (RMSA). According to K/HS-410, an RMSA is an area where radioactive materials are stored; however, no limit of radioactivity is defined for the placement of material in an RMSA. The facility is considered inactive.

One auxiliary transformer outside K-707 contained mineral oil with a PCB concentration of 56 ppm. The transformer is located in a non-radiological facility and is surrounded by five non-radiological facilities.

In the K-726 RRCA vault, one power transformer contained mineral oil with a PCB concentration in excess of 500 ppm. K-726 is designated a Hazardous Waste Storage Area. It is listed as an active contaminated area in the middle of an outdoor radiological area.

Outside K-892, one lighting transformer contained mineral oil with a PCB concentration of 129 ppm. The transformer is located outside a non-radiological facility.

Outside K-1037D in a non-radiological area are three power transformers that contained mineral oil with PCB concentrations in excess of 500 ppm.

Outside K-1131, the Gaseous Diffusion Feed and Withdrawal Facility, there are three power transformers. Two contained fluids with PCB concentrations in excess of 500 ppm, and one contained mineral oil with a PCB concentration of 51 ppm. It is a high-contamination area, defined in K/HS-410 as an area where contamination levels are greater than 100 times the values listed in ***Table 3.1*** of this assessment (p. 3-6). K-1131 is currently in shutdown mode and is surrounded by an outdoor radiological area.

Outside K-1301 in a non-radiological area is one power transformer that contained mineral oil with a PCB concentration in excess of 500 ppm.

K-862 contains two power transformers that contained mineral oil with PCB concentrations in excess of 500 ppm. The transformers are located outside a non-radiological facility between a non-radiological facility and a contaminated area.

The 87 askarel transformers and 8 askarel tanks (***Table 2.2***) are located in the K-33 process building. Due to their sizes and weights, the transformers will continue to be stored in this facility. TSCA-compliant diking is being constructed around each individual transformer in K-33. Energy Systems currently inspects these units once per quarter.

In summary, the equipment inventory consists of:

- 80 units whose fluids contained 50 ppm - $<$500 ppm PCB, and
- 119 units whose fluids contained $\geq$500 ppm PCB.

For the sake of discussion, all electrical equipment addressed in this assessment will be referred to as "transformers."

2.1.2 Dielectric Fluid Considerations

Transformers may be filled with either mineral oil or askarel dielectric fluids. Transformers are classified as non-PCB equipment, PCB-contaminated equipment, or PCB equipment, depending upon the concentration of PCBs in the fluid (see Section 3.1).

Askarel is a generic name for a group of synthetic, fire resistant, chlorinated, aromatic hydrocarbons used as electrical insulating liquids. All are manufactured under the generic name "Aroclor." Manufacturers use trade names such as Pyranol, Inerteen, Chloroextol, No-Flamel, and Asbestol for the dielectric liquid used in their electrical equipment.

Another key consideration of the fluids is their potential radioactive contamination. Any materials, including the subject fluids, may contain naturally occurring radioactive constituents from the earth that have survived processing. Radioactive materials in trace levels are widely distributed throughout the world from atomic bomb tests and nuclear accidents, for example. Accordingly, the fluids can be considered to have no radioactivity added if the content of radioactive materials in the fluid is not statistically greater than that in fluids from transformers located off the Oak Ridge Reservation (ORR). To address this issue, Energy Systems compared analyses of transformer fluids from the Knoxville Utilities Board (KUB) and Tennessee Valley Authority (TVA)* with those of the K-25 transformers. Scatter charts of the three sets of analyses were prepared by Energy Systems (ref. 3). A preliminary study of these charts indicates that there is not a great difference between the levels of radioactivity in the K-25 fluids and those in the commercial fluids.

Note that sampling and analysis (S&A) of the transformer fluids has been performed only in a preliminary manner. No formal S&A Plan was prepared, nor were chain-of-custody forms used. Moreover, the fluids were not analyzed for radionuclides other than uranium. Accordingly, formal S&A activities will have to be performed on the transformer fluids to generate the defensible data to support "official" actions such as off-site shipment. The S&A plans will follow the guidance of *Site Project Management Organization Quality Assurance Program (SPMO-QAP)*, 19-92-0001/R0 (ref. 4) (see Section 8.3). Energy Systems maintains that there is sufficient residual fluid remaining in the transformers to make this S&A effort possible. By the same token, formal S&A activities will also have to be performed on KUB and/or TVA transformer fluids. The resulting analyses should then be compared statistically.

2.1.3 Treatment and Disposal of Transformer Fluids

The askarel and mineral oil dielectric fluids have been drained from all transformers of concern and disposed of (***Table 2.3***), although some residual fluid remains. In March 1991, Environmental Systems Company (ENSCO) of Arkansas disposed of 116,000 gal of askarel dielectric fluid through incineration. Chemical Waste Management incinerated the remaining 8,000 gal of this askarel dielectric fluid and 8,000 gal of mineral oil dielectric fluid in the spring of 1990. Due to capacity limitations, not all of the mineral oil dielectric fluid was incinerated by Chemical Waste Management; some of the fluid was sent to Rollins in Texas. The remaining mineral oil dielectric fluid was disposed of by the TSCA incinerator at K-25. During the summer of 1991, 15,000 gal of mineral oil dielectric fluid was incinerated and 39,000 gal was incinerated in January through March 1992.

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*Although TVA operates nuclear power plants, the transformers in question were located at the Kingston and Bull Run Steam Plants, both of which are coal-fired.

The askarel and mineral oil were not regulated as radioactively contaminated for either transportation or disposal purposes. However, off-site shipments of dielectric fluids took place prior to the October 1991 publication of EM-30's *Performance Objective for Certification of Nonradioactive Hazardous Waste* (i.e., the Objective; see Section 4.1.1). The disposal of the askarel and mineral oil dielectric fluid has been completed. With the exception of residual fluids, no PCB-contaminated askarel or mineral oil from these transformers is stored at K-25.

Table 2.3. Disposition of Transformer Fluids

Type of Dielectric Fluid	Gallons of Dielectric Fluid	Incinerator Facility	Date
Askarel	116,000	ENSCO	March 1991
	8,000	Chemical Waste Management or Rollins	Spring 1990
Mineral Oil	8,000	Chemical Waste Management or Rollins	Spring 1990
	15,000	K-25 TSCA	Summer 1991
	39,000	K-25 TSCA	January through March 1992

2.2 SUMMARY OF ALTERNATIVES

2.2.1 Alternative 1: Off-Site Release as Nonradioactive Waste

This alternative is defined in Section 1 as: "Certification by Energy Systems that some or all of the transformers are not radioactive waste, followed by shipment to a commercial transformer treatment and/or disposal facility."

Any transformers that can be shown to be nonradioactive can be released off site either as unregulated, PCB-contaminated equipment or as PCB equipment under TSCA. In order to ensure that transformers can be released, concerns about the Health Physics survey and EM-30's Objective must be addressed as described in Section 4.0 of this report.

Section 7 of this report covers the feasibility of pre-treatment alternatives.

2.2.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

This alternative is defined in Section 1 as: "Determination or assumption that some or all of the transformers are PCB/radioactive waste, followed by shipment to a facility able to accommodate both the PCB and radioactive contamination."

A commercial facility permitted by both the U.S. Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission (NRC) could accept the transformers as PCB/radioactive waste.

At least one facility, Scientific Ecology Group (SEG) in Oak Ridge, holds an NRC license and manages significant amounts of radioactively contaminated metals for DOE facilities. Although SEG does not currently hold a TSCA permit for incineration of PCBs, it is currently considering obtaining one.* Further discussions with SEG are recommended.

No existing TSCA-licensed facility holds an appropriate NRC license. Discussions with four major PCB-treatment facilities indicate that no vendor is seeking an NRC license to dispose of these transformers at this time. Hence, this alternative will only become viable if and when a vendor, such as SEG, becomes both TSCA and NRC licensed.

2.2.3 Alternative 3: On-Site Treatment

This alternative is defined in Section 1 as: "Determination or assumption that some or all of the transformers are PCB/radioactive waste, followed by on-site treatment to remove both the PCB and radioactive constituents, followed by shipment to a disposal/recycling facility."

On-site treatment of the transformers as PCB/radioactive waste is possible through several processes. Either solvent-based PCB removal or thermal PCB destruction is possible with radioactive constituents being removed at the same time through certain modifications of the processes. The options are discussed in detail in Section 7 of this report. The TSCA incinerator on site and the SEG shielding manufacturing facility nearby serve as valuable resources under this alternative.

*Due to the current size limitations of their facilities, SEG is not now able to take transformers above approximately 50,000 lb. However, they have indicated a willingness to increase this limitation.

3.0 PROJECT JUSTIFICATION

This section provides an overview of TSCA regulations, U.S. Department of Transportation (DOT) regulations, the UE-FFCA, and DOE orders and guidelines. The regulatory and the administrative requirements that make timely, cost-effective disposal of the transformers necessary, as well as the constraints imposed on these activities, are explained in the following sections.

3.1 TSCA REGULATIONS

TSCA prescribes management and design features required for PCB handling and disposal. Equipment intended for reuse must be managed as in-service equipment under TSCA requirements (40 CFR 761.30). PCB regulations under TSCA are found in 40 CFR 761, Subpart D. Essentially, TSCA defines three types of equipment relative to the PCB concentration in their fluids:

1. Non-PCB equipment contains <50 ppm PCB.

2. PCB-contaminated electrical equipment contains 50 ppm - <500 ppm PCB.

3. PCB transformers contain ≥500 ppm PCB.

3.1.1 Definitions

Storage, shipping, treatment, and disposal requirements vary depending upon the TSCA category. From 40 CFR 761.3, the categories of PCB equipment relevant to this assessment are:

- **Excluded PCB Products.** PCB materials that appear at concentrations less than 50 ppm (specific examples are given in 40 CFR 761.3).

- **Non-PCB Transformer.** Any transformer that contains less than 50 ppm PCB. Any transformer that has been converted from a PCB Transformer or a PCB-contaminated transformer cannot be classified as a non-PCB Transformer until reclassification has occurred in accordance with the requirements of 40 CFR 761.30(a)(2)(v).

- **PCB Article.** Any manufactured article, other than a PCB container, that contains PCBs and whose surface has been in direct contact with PCB. This includes capacitors, transformers, electric motors, pumps, pipes, etc.

- **PCB Article Container.** Any package, can, bottle, bag, barrel, drum, tank, or other device used to contain PCB Articles or PCB Equipment, and whose surface has not been in direct contact with PCBs.

- **PCB Container.** Any package, bottle, bag, barrel, drum, tank, or other device that contains PCBs or PCB Articles and whose surface has been in direct contact with PCBs.

- **PCB-Contaminated Electrical Equipment.** Any electrical equipment including, but not limited to, transformers, capacitors, circuit breakers, reclosers, voltage regulators, switches, electromagnets, and cable, that contain 50 ppm PCB or greater, but less than 500 ppm PCB.

- **PCB Equipment.** Any manufactured item, other than a PCB Container or PCB Article Container, which contains a PCB Article or other PCB Equipment, and includes microwave ovens, electronic equipment, and fluorescent light ballasts and fixtures.

- **PCB Item.** any PCB Article, PCB Article Container, or PCB Equipment that deliberately or unintentionally contains or has as a part of it any PCB or PCBs.

- **PCB Transformer.** any transformer that contains 500 ppm PCB or greater.

- **PCB Waste.** those PCBs and PCB Items that are subject to the disposal requirements of Subpart D of Part 761.

PCB transformers and PCB-contaminated electrical equipment are regulated under TSCA. Disposal options for PCB transformers include incineration, landfill, or conversion to PCB-contaminated electrical or non-PCB equipment. Chemical waste landfills used for the disposal of PCBs and PCB items must be TSCA-permitted and meet the requirements of 40 CFR 761.75.

3.1.2 Decontamination, Conversion, and Reclassification

Reclassification to lower-level categories is possible and useful in defining options for reuse, reclamation, or disposal. Conversion for reuse involves draining the PCB-containing dielectric fluid and replacing it with non-PCB dielectric fluid or with fluid containing a lower PCB concentration [40 CFR 761.30(a)(2)(v)]. The reclassification category depends upon the fluid's PCB concentration following three months of in-service use. In-service use is defined as use that raises the temperature of the dielectric fluid to at least 50°C. However, alternative methods may be granted by the Director of the Exposure Evaluation Division of the EPA.

TSCA regulations allow reclassification [40 CFR 761.30 (a)(2)] and decontamination of containers (40 CFR 761.79). The disposal of drained transformers whose fluids contained less than 500 ppm PCBs are unregulated under TSCA [40 CFR 761.60(b)(4)]. Clarification of the proper disposal and recycle of this category of transformers is provided in ref. 5. Drained transformers whose fluids contained 500 ppm PCB or greater require further decontamination prior to off-site release (see Section 7.1.3, Alternative 3). Normally, storage for disposal is limited to 1 year and storage areas must comply with 40 CFR 761.65; however, the UE-FFCA allows K-25 to store radioactive materials for longer than 1 year (Attachment II, Section D).

3.1.3 Preparation for Shipment

TSCA regulates both the storage and transportation of PCB wastes. TSCA storage requirements impact DOT requirements when the shipment is en route for a period greater than 10 days. After 10 days, the transportation vehicle is considered a storage facility and requires a TSCA permit [40 CFR 761.65(d)(5)]. If the PCB wastes will be disposed within 10 days, the generator needs only to comply with DOT regulations. Per TSCA regulations, labels are required on PCB Containers, PCB Transformers, PCB large High Voltage Capacitors, equipment containing a PCB Transformer or a large High Voltage Capacitor, PCB large Low Voltage Capacitors, electric motors using PCB coolants, hydraulic systems using PCB hydraulic fluid, heat transfer systems using PCBs, and PCB Article Containers. Labeling of PCB-Contaminated Electrical Equipment is not required [40 CFR 761.40(a)(2)].

Also, the generator who relinquishes control over PCB wastes by transportation must prepare a manifest using EPA Form 8700-22 [40 CFR 761.207]. The generator shall specify:

1. for each bulk load of PCBs, the identity of the PCB waste, the earliest date of removal from service for disposal, and the weight in kilograms of the PCB waste;

2. for each PCB Article Container or PCB Container, the unique identifying number, type of PCB waste (e.g., soil debris, small capacitors), earliest date of removal from service for disposal, and weight in kilograms of the PCB waste contained; and

3. for each PCB Article not in a PCB Container or PCB Article Container, the serial number if available, or other identification if there is no serial number, the date of removal from service for disposal, and weight in kilograms of the PCB waste in each PCB Article.

Further manifest requirements are specified in 40 CFR 761 Sections 208 and 209.

3.2 U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS

DOT regulations are designed to protect the public during the transportation of materials including radionuclides. DOT regulations also address PCBs, but define them as "Class 9"; as such, shipment of PCBs is much less stringently controlled than that of radioactive wastes and materials. DOT defines radioactive material, essentially establishing a level of regulatory concern, and provides guidance on the level of removable contamination allowable on surfaces and on allowable radiation from materials being transported.

DOT regulations define radioactive material as any material having a specific activity greater than 0.002 μCi/g (49 CFR 173.403). For DOT to consider the transformers radioactive, a conservative position would be that the external contamination, including that fixed in paint, would, in bulk, have to exhibit a specific activity greater than this limit. This total activity could be reduced by removing surface contamination.

DOT regulations state that "the level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for shipment shall be kept as low as practicable" (49 CFR 173.443). The phrase "as low as practicable" is not clearly defined by the regulations, but the level of non-fixed radioactive contamination can be determined by methods that include process knowledge, survey, and sampling. This approach is consistent with that presented by EM-30 in the Objective (see Section 4.1.1). Specific requirements for contamination control are presented in Table 10 of 49 CFR 173.443. With wipe testing, the maximum permissible limits for removable contamination are 10^{-5} μCi/cm^2 (22 dpm/cm^2) for beta-gamma emitters (all nuclides with half-lives less than ten days; natural uranium; natural thorium; ^{235}U; ^{238}U; ^{232}Th; ^{228}Th; and ^{230}Th when contained in ores or physical concentrates) and 10^{-6} μCi/cm^2 (2.2 dpm/cm^2) for all other alpha emitters when shipped only by rail or public highway as an exclusive use shipment. DOE requirements specified in DOE Order 5400.5 are more stringent than these values. Other, more accurate testing methods may allow these limits to be increased by a factor of ten. Essentially, removable radioactive contamination is considered insignificant by DOT (according to 49 CFR 173.403) if it does not exceed the limits specified in 49 CFR 173.443. If the transformers do not exceed the limits for surface radioactivity, then they are not considered a "significant" radioactive material and are therefore not regulated by DOT.

DOT also establishes radiation-level limitations (49 CFR 173.441). Each package of radioactive materials transported must be designed and prepared for shipment so that, under normal conditions, the radiation level does not exceed 200 mrem/h at any point on the external surface of the package. If the package exceeds the 200 mrem/h limit, then that package may only be shipped "exclusive use." It may be shipped at 1,000 mrem/h under some restrictions [see 49 CFR 173.441 (b)(1)]. These limitations are extremely unlikely to apply to the transformers.

The key element of DOT regulations as they apply to the transformers is that they provide a specific lower limit of regulatory concern for both the specific activity of materials and the surface contamination of articles.

3.3 EXISTING TSCA URANIUM ENRICHMENT FEDERAL FACILITIES COMPLIANCE AGREEMENT

The existing TSCA UE-FFCA that affects the K-25 PCB transformers has DOE headquarters and EPA headquarters as signatories. This agreement became effective in February 1992, and includes a remedial implementation plan for K-25. Attachment II, Section D, of this remedial implementation plan specifically incorporates the K-25 PCB transformers and provides a deadline for their disposal. Essentially, DOE and EPA agreed that the transformers will be drained, the drained fluid properly disposed of, and carcasses sealed by September 30, 1994, on the basis of Section (D)f; by October 1, 1991, for askarel-filled transformers; and March 31, 1992, for all mineral oil-filled transformers under Section (D)g. This is a contradiction, and EPA recognizes the earlier dates. However, the transformer draining has been completed, meeting the requirements of both subsections. The UE-FFCA requires that K-25 certify that only PCB/radioactive materials, and PCB items that have been in storage for less than 1 year, continue to be stored. This certification must occur by September 30, 1995. The UE-FFCA requires all PCB items to be placed in storage by the earlier date of September 30, 1994.

3.4 APPLICABLE DOE ORDERS AND GUIDELINES

DOE's goals include operating its facilities and conducting its activities so that radiation exposures to the public are maintained within the limits established in DOE Order 5400.5; controlling radioactive contamination through the management of real and personal property; keeping potential exposures to members of the public below these limits and "as low as reasonably achievable" (ALARA); and ensuring that DOE facilities have the capabilities, consistent with the types of operations conducted, to monitor routine and non-routine releases and to assess doses to the public. The primary standard for DOE is 100 mrem effective dose equivalent to members of the public in 1 year. This limit is in addition to doses received from medical exposures, consumer products, naturally occurring radiation sources, and from exposures due to accident conditions where controls of exposure cannot be maintained. DOE Orders 5480.5 and 5480.6 are also applicable to the control of radioactive release, but these orders also discuss accident-related aspects of radiation control.

The ALARA process requires "judgment with respect to what is reasonably achievable," including factors that relate to societal, technological, economic, and other public policy considerations, as practicable. Minimum factors considered in the ALARA process include:

1. maximum dose to members of public
2. collective dose to population
3. alternatives
4. doses for alternatives
5. costs for each alternative
6. examination of the changes in cost among alternatives
7. changes in societal impact associated with process alternatives

Except for meeting requirements of the National Environmental Policy Act (NEPA), documented qualitative analyses are acceptable, in most instances, for ALARA judgments, especially where potential doses are well below the dose limit.

The generic surface contamination guidelines for unrestricted release are provided in Figure IV-1 in DOE Order 5400.5 and are applicable to existing structures and equipment. These guidelines are consistent with the NRC standards (ref. 6) set forth in Section 4, "Decontamination for Release for Unrestricted Use," of Regulatory Guide 1.86, and apply only to nonreactor facilities. These limits apply to both interior equipment and building components that are potentially salvageable or recoverable scrap. Where surface contamination by both alpha- and beta-gamma—emitting radionuclides exists, the limits established for alpha- and beta-gamma—emitting radionuclides should apply independently. For objects with surface area less than 1 m^2, the average should be derived for each object. The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

DOE guidelines on surface contamination for unrestricted release are straightforward. DOE's intent is that materials intended for unrestricted release contain residual radioactive material at levels that are as far below authorized limits as reasonable considering technical, economic, and social factors. Generic surface contamination guidelines are adopted from standards of the NRC and are intended to provide protection consistent with those standards. These guidelines are summarized in ***Table 3.1***.

3.5 IMPACTS OF HOST STATE REQUIREMENTS

This section addresses standards for the transportation, treatment, and disposal of hazardous/toxic* wastes in several states. Some are states in which candidate vendor facilities are actually located (i.e., West Virginia, Ohio, and Kansas). Others are merely states through which the wastes might be transported en route to a vendor facility (i.e., Arkansas, Oklahoma, Missouri, Kentucky, and Tennessee).

The assessment concludes that none of the host-state requirements will have an impact on the project, assuming that Alternative 1 is selected (see Section 9). None of the states in question impose limits on the transportation, treatment, or disposal of PCB transformers that are any more stringent than those imposed by DOT, DOE, or EPA.

3.5.1 <u>West Virginia</u>

West Virginia standards for treatment and disposal of hazardous wastes are consistent with and are not more stringent than the rules and regulations of the EPA pursuant to RCRA (West Virginia Code, Chapter 20, Natural Resources, Article 5E, Hazardous Waste Management Act, Section 6). For transport, West Virginia requires a manifest as well as appropriate labeling and containerization of all hazardous waste. West Virginia has no special state requirements concerning PCBs.

*This assessment recognizes that PCBs are not a "hazardous waste" per RCRA (40 CFR 261) or corresponding state regulations in any of the states addressed.

Table 3.1. DOE Surface Contamination Guidelines (from DOE Order 5400.5)

Radionuclides[b]	Allowable Total Residual Surface Contamination (dpm/100 cm^2)[a]		
	Average[c,d]	Maximum[d,e]	Removable[d,f]
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100[g]	300[g]	20[g]
Th-Natural, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{131}I, ^{133}I	1,000	3,000	200
U-Natural, ^{235}U, ^{238}U, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above	5,000 β-γ	15,000 β-γ	1,000 β-γ

[a] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[b] Where surface contamination by both alpha- and beta-gamma—emitting radionuclides exists, the limits established for alpha- and beta-gamma—emitting radionuclides should apply independently.

[c] Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of surface area less than 1 m^2, the average should be derived for the entire surface area of each such object.

[d] The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[e] The maximum contamination level applies to an area of not more than 100 cm^2.

[f] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

[g] The February 8, 1990, version of DOE Order 5400.5 shows "Reserved" for the allowable average, maximum, and removable levels of these radionuclides. The numbers listed here are from Nuclear Regulatory Commission, Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table I, June 1974.

3.5.2 Ohio

Ohio has established in Title 37 (Health, Safety, and Morals, Chapter 3734, Solid and Hazardous Wastes) standards for the storage and disposal of PCBs. These standards are "identical to federal laws and regulations governing the storage and disposal of PCBs" (Title 37, Chapter 3734.122).

For hazardous materials transport, Ohio requires the transporter to be registered and the delivery to be made to an approved TSD facility. Ohio also requires: (1) accurate records that identify the quantities of hazardous waste to be disposed of; (2) labeling of containers used for storage, transportation, or disposal of hazardous waste to identify the waste accurately; (3) use of appropriate containers; (4) dispersal of information on the general chemical composition of hazardous waste to persons transporting, treating, storing, or disposing of waste; (5) a manifest as prescribed under RCRA; (6) obtainment of an EPA ID number; and (7) contingency plans to minimize unanticipated damage from transportation of hazardous waste.

3.5.3 Kansas

Kansas has established in Title 28 (Department of Health and Environment, Article 31, Hazardous Waste Management Standards and Regulations, Section 5) standards for transport and disposal of hazardous waste in the state. A hazardous waste disposal authorization is required from the Kansas Department of Health and Environment for disposal in Kansas.

Kansas requires the transporter to register with the Kansas Department of Health and Environment and carry a copy of the written acknowledgment, which must be available for review upon request. Kansas also requires the transporter to secure and maintain liability insurance on all vehicles transporting hazardous waste. The limits of insurance may not be less than $500,000 per person and $500,000 per occurrence for bodily injury or death, and $500,000 for all damages to the property of others. The transporter must also carry a manifest, the EPA ID number of the generator and the hazardous waste, and must appropriately label and package the hazardous waste. The transporter must comply with regulations set forth by the DOT and select a route that minimizes risk to public health and safety. To choose the route, the transporter must consider available information on accident rates, transit time, population density and activities, time of day, and day of week during which transport will occur.

3.5.4 Arkansas State Requirements for Hazardous Materials Transport

Under Section 16 of 1116.0552, Arkansas sets requirements for hazardous waste transportation and reporting for PCB transportation in addition to the provisions of 40 CFR 262, 263, 264 Subpart E, and 265 Subpart E. PCBs, PCB items, PCB transformers, and PCB-contaminated electrical equipment as defined in 40 CFR 761.2 constitute a hazardous waste for purposes of transportation in the state of Arkansas. Generators of such waste must comply with the following:

1. Each generator and transporter of PCB wastes must obtain an EPA identification number.
2. Each generator must file a manifest and obtain a transportation permit from the Arkansas Highway and Transportation Department.
3. The manifest must include the phone number of the transporter and the phone number of the designated facility.
4. The manifest must also contain the EPA Waste Code or the letter "PCB" for PCB shipments.
5. The manifest must have the name, address, and ID number of an alternate TSD facility (if any).
6. The manifest must contain an emergency response contact (individual's name and telephone number).

7. For rail transportation, the first and last rail transporter delivering the shipment must sign and date the manifest or continuation sheet in the appropriate space on the manifest.
8. Each manifest that shows a weight difference of more than 10% between the initial and final weights must include documentation showing that the weight variance has been resolved between the generator and the TSD facility. A discrepancy report must also be filed with the department that contains the information required by 40 CFR 265.72 for those shipments to an out-of-state TSD facility involving significant discrepancies as defined by 40 CFR 265.72.

In addition to the requirements for immediate action in the event of a discharge during transportation, required by 40 CFR 263.30, a transporter who has discharged hazardous waste in the state of Arkansas shall also take the following actions:

1. Give immediate notice to the Arkansas State Police and to the principal office or designated agent of the transporter, and
2. Submit a copy of the written report required by 49 CFR 171.16 and 263.30 to the Arkansas Department of Pollution Control and Ecology simultaneously with its submission to the federal DOT.

All persons who transport hazardous waste in or through any part of the state of Arkansas shall obtain state permits for these activities, and shall comply with all federal rules and regulations governing such transportation.

3.5.5 Oklahoma State Requirements for Hazardous Materials Transport

In Oklahoma, for transportation purposes, the hazardous component of mixed waste and radioactive waste is regulated as hazardous waste. The radioactive waste component is regulated as radioactive waste. Both the hazardous waste requirements and the radioactive waste requirements apply for mixed waste [Oklahoma Hazardous Waste Act, Section 2005(1)].

Rules and regulations pertaining to standards for the transportation of hazardous waste and recyclable materials may not be more stringent than those of the DOT [Oklahoma Hazardous Waste Act, Section 2005(4)].

Oklahoma has no special state regulations concerning PCBs.

3.5.6 Missouri State Requirements for Hazardous Materials Transport

Under 10 Code of State Regulations (CSR) 25-6.263, Missouri regulates the equipment used in the transportation of hazardous waste and requires transporters to meet the standards of the Missouri Department of Economic Development's Division of Transportation, the DOT, and/or the Federal Railroad Administration, as applicable for the types of hazardous materials transported. It also states that the equipment to be used in the transportation of hazardous waste must be compatible with that waste and must be adequate to protect the health of humans and prevent damage to the environment. Missouri requires a detailed manifest to transport hazardous waste through the state. Items on the manifest include:

1. Each generator and transporter of hazardous materials must obtain an EPA ID number.
2. Each generator must file a manifest and obtain a transportation permit.
3. The manifest must include the phone number of the transporter and the phone number of the designated facility.

4. The manifest must have the name, address, and ID number of an alternate TSD facility.
5. The manifest must contain an emergency response contact (individual's name and telephone number).

The state of Missouri also collects a fee for hazardous materials transported through its state. Missouri has no special state regulations concerning PCBs.

3.5.7 Kentucky State Requirements for Hazardous Materials Transport

Kentucky requires all hazardous materials transporters to have a manifest that is signed in accordance with the provisions of Section 1 of 401 Kentucky Administrative Regulations (KAR) 32:020, an EPA ID number for the hazardous waste, and accurate records of all shipments (KAR, Title 401, Natural Resources and Environmental Protection Cabinet, Division of Waste, Chapter 33:010). Kentucky has no special state requirements for the transport of PCBs.

3.5.8 Tennessee State Requirements for Hazardous Materials Transport

Tennessee regulations on transportation, containerization, and labeling of hazardous waste are consistent with those issued by the DOT and the Tennessee Public Service Commission (Tennessee Code, Title 68, Safety and Health, Chapter 46, Hazardous Waste Management, Section 107). Tennessee has no special state regulations concerning transport of PCBs.

4.0 UNCERTAINTIES

4.1 INTERPRETATION OF "NO RAD ADDED" POLICY

4.1.1 EM-30 Performance Objective

EM-30 developed and issued *Performance Objective for Certification of Nonradioactive Hazardous Waste* (ref. 1), also known as the "no rad added policy." This document, referred to as the Objective, and its interpretation provide concern over the potential for existing trace radioactive contamination to the otherwise straightforward recycling of the K-25 transformers. The goal of the Objective is "to assure that hazardous/toxic waste(s) shipped from DOE facilities to commercial treatment, storage, or disposal facilities have no bulk or volume radioactive contamination added as a result of DOE operations and are in compliance with DOE Order 5400.5 criteria for surface contamination unless the receiving facility is specifically licensed to manage radioactive waste."

The document specifically addresses wastes regulated by TSCA, thereby extending its scope to the K-25 transformers. The Objective serves as interim guidance pending the establishment of risk-based numerical limits for the release of waste that is believed to have an insignificant impact upon public health and the environment.

This need for guidance on the bulk release of wastes with trace quantities of radioactivity arises primarily from the absence of a federally established *de minimis* level of radioactivity in wastes, resulting in inconsistent criteria and methods for release detection across the DOE system. The definition of waste and the definition of what represents radioactive contamination in bulk or volume are the primary elements subject to interpretation.

TSCA regulations appear to classify the K-25 transformers as waste because their useful life is terminated. This represents disposal under 40 CFR 761.3 because the potential disposition of the transformers involves either landfilling or recycling, with some elements incinerated.

The Objective delineates nonradioactive wastes as those wastes that:

1. contain no measurable increase in radioactivity (at a statistically defined confidence interval) above background in volume or bulk resulting from DOE operations, and

2. contain no surface radioactivity above limits established in DOE Orders (specifically DOE Order 5400.5) or guidance.

For wastes that are potentially PCB/radioactive, three cases are possible:

1. The waste is a PCB/radioactive waste and is stored, treated, and disposed of at DOE facilities.

2. The waste is a PCB waste certified as nonradioactive and is shipped off site for treatment and disposal.

3. The waste is a PCB/radioactive waste and is shipped to an NRC-licensed, off-site commercial facility for treatment of the PCB component, then returned to DOE for treatment and disposal of the radioactive component.

The Objective relies upon "statistically valid deviance" from background radiation levels for nonradioactive waste screening criteria, but fails to define what this means. The screening may be undertaken on the basis of either process knowledge, radiological survey, or S&A.

Waste determinations based upon process knowledge rely upon the potential that items were exposed to radioactive materials. The first criterion is the source of the waste. If the waste material came from outside a Radioactive Materials Management Area (RMMA), as defined in the Objective, then the waste can be classified as nonradioactive under the Objective. If a waste comes from inside an RMMA, then process knowledge still provides information for screening, especially with regard to the contents of containers, but may not be convincing.

The Objective requires documentation of the rationale for the determination of nonradioactivity; and that the waste be certified by individuals with appropriate training and cognizance of the origin, use, and potential for exposure of the waste to the radioactive materials in question. RMMA waste that cannot be definitively declared either radioactive or nonradioactive by process knowledge must be considered potentially contaminated and must undergo S&A. A survey of materials from within an RMMA must follow documented procedures with regard to criteria, number and type of samples, statistical bases for sample frequency, error, etc. For example, radiological survey results for waste from an RMMA can be compared to results for comparable materials obtained from a non-RMMA to determine the normal level of radionuclides.

As stated in Section 2.1.2, levels of radioactivity in fluids drained from the K-25 transformers appear to be no greater than those from transformers in commercial use (although further S&A activities on both types of transformers are required to substantiate this). This assessment assumes that uncontaminated fluids are necessary and sufficient proof of an uncontaminated transformer interior. A given transformer may have undergone numerous drain/fill cycles during its service life, and thereby been exposed to varying levels of interior contamination. However, we assume that the final inventory of fluid will have desorbed sufficient radioactivity to render the interior uncontaminated following draining of the fluid and immediate sealing of the empty unit.

The Objective does not state that the entire surface area of a given unit be surveyed for radioactivity. Only a statistically significant portion of the surface area needs to be surveyed. See Section 4.2 for additional information.

4.1.2 Interpretation of the Objective

Energy Systems has provided a draft document interpreting the Objective (ref. 7). This document, referred to as the Evaluation, concludes that the "no rad added" approach is consistent with a strict and literal interpretation of NRC regulations. Such a blanket policy avoids having to evaluate the exposure pathway for each shipment and treatment, storage, or disposal (TSD) facility to determine the dose or risk associated with managing the low level of radioactivity that may be present in wastes not generally considered to be contaminated.

According to the Evaluation, the Objective does not state whether the "no rad added" approach is based on contamination levels that (1) are Below Regulatory Concern (BRC), (2) are *de minimis*, or (3) comply with dose- or risk-based regulations. BRC wastes are those with sufficiently low radioactive content that the effort and expense of further regulation overshadows any further gain in risk reduction. *De minimis* wastes are those that have a sufficiently small radioactive content to present a trivial risk. The *de minimis* level is generally below the BRC level and, under some interpretations, would be a non-measurable level. The regulatory compliance route implies a management of liability by meeting the requirements of existing regulations derived for generic circumstances, rather than by analyzing case-specific risks to workers, the public, and the environment. These different approaches require different levels of data quality and assurance for a nonradioactive determination.

Additional points made in the Evaluation are as follows:

1. The surface contamination limits of DOE Order 5400.5 (Figure IV-1 of the Order) are applicable to equipment that is potentially recoverable scrap. The K-25 transformers can be considered recoverable scrap, with only the combustible transformer fluid, paper, and wood representing non-recoverable or recyclable waste. The Order states that:

   The authorized limits for each property shall be set equal to the generic or derived guidelines unless it can be established, on the basis of specific property data (including health, safety, practical, programmatic and socioeconomic considerations), that the guidelines are not appropriate for use at the specific property.

2. The Order distinguishes between fixed and removable residual surface contamination. A wipe survey to determine removable surface contamination levels is not required if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

3. The concept of "no rad added," as well as the phrase itself, contribute and sustain ambiguity and confusion to the Objective. Radioactivity does not exist in discrete packages, but rather represents a random process governed by Poisson statistics. No object is entirely free from radioactivity; thus, the level of radioactivity associated with a given object lies somewhere on a continuous scale, and may approach, but never reaches, zero. Radioactivity either lies within a level associated with ambient background or can be statistically shown to be significantly higher than ambient background. The very nature of radioactivity adds to the difficulty with the "no rad added" provision of the Objective.

The Objective, as it now stands, provides an uncertain and incomplete body for guidance, primarily due to the "no rad added" provision. The document indicates that its overall intent was <u>not</u> to provide a complete moratorium on all off-site shipments of waste, but rather to ensure that DOE facilities not ship radioactively contaminated materials off site. The Evaluation makes a pragmatic recommendation to allow commercial facilities to specify in their contract the acceptable level of radioactivity for their facility. This issue should be thoroughly addressed by Energy Systems prior to entering into negotiations with these facilities.

4.1.3 <u>Assessment of the Objective and the Evaluation</u>

The clear intent of the Objective is to minimize the release of radioactively contaminated materials and the resulting potential for harm to public health and the environment. The Objective contains the statement: "There are no generic below regulatory concern or *de minimis* tests for defining radioactive material," (p. 4, Section 5.0). The Objective satisfies the goal of screening materials for radioactive contamination prior to unrestricted release through (1) ensuring that the surface contamination limits for unrestricted release, as specified in DOE Order 5400.5, are met; and (2) determining that no radioactive materials have been added to the bulk or volume of the material. Surface contamination concerns the exterior of the transformers; bulk or volume contamination addresses the core of the transformer, with its absorbent paper and wood components.

Based on Section 6.1 of the Objective, any transformers originating outside RMMAs at K-25 can be classified as nonradioactive. Energy Systems D&D personnel indicate that none of the subject transformers fall into the non-RMMA category.

Two issues exist for transformers located within any RMMAs: 1) potential surface contamination, either fixed or removable; and 2) potential contamination of the contents of the transformers.

The Order clearly intends that materials released from DOE facilities satisfy the same criteria for surface contamination as materials released from facilities regulated by the NRC. These requirements, as indicated in DOE Order 5400.5 and other guidance, include specific levels for unrestricted release.

The Objective indicates that process knowledge is sufficient to demonstrate the absence of radioactive contamination. In this case, process knowledge reveals that the transformers have been opened, drained, and possibly refilled over their lifetime. The transformers probably were not exposed to radioactive contaminants for any but short periods, if at all. Unless contamination control was inadequate in the areas housing the transformers, no credible route for contamination above background appears to exist. If contamination sufficient to penetrate the core and windings entered the transformers, then the fluid would remain significantly contaminated (see assumption in Section 4.1). This fluid contains a level of radioactivity consistent with that of transformers from off site, as covered in Section 2.1.2 of this report; therefore, no contamination of the volumetric bulk of the transformers is credible. This combination of process knowledge and S&A demonstrates that no radioactivity could have been credibly added. Rather than taking the view that an object must be demonstrated to be 100% free of any potentially added radioactivity, the "process knowledge/S&A" approach is intended to show that the level of radioactivity is not appreciably different from that associated with similar equipment from non-nuclear facilities, and will not adversely impact human health and the environment.

4.2 HEALTH PHYSICS SURVEY

The most straightforward method for disposing of the transformers involves certification of noncontamination by Health Physics. Under Section 6.1 of the Objective, if the transformers lie outside an RMMA, no survey is required and such transformers can be considered simply PCB items. For transformers within RMMAs, both the interiors and exteriors need to be certified as uncontaminated. This section addresses survey of the exteriors.

The exteriors of the transformers are difficult to survey because: (1) they may have been exposed to radioactive particulates, potentially creating a layer of removable contamination; and (2) some have been painted, potentially fixing and/or shielding contamination under or within the paint (especially if the paint is lead based). The "no rad added" policy does not require that the entire surface area of a given unit be surveyed, but rather stresses that a statistically valid survey be performed under formal, documented procedures. DOE Order 5400.5 provides guidance for conducting such a survey, including:

- a detailed wipe procedure and mention of direct scanning (Figure IV-1, footnote 6; reproduced in this assessment in footnote f of Table 3-1);
- by implication, an exemption from 100% survey of any object whose surface area exceeds 100 cm^2 (same source); and
- an exemption from the survey of "inaccessible areas" [Chapter II, Section 5.c.(4), p II-11].

5.0 POLICY CONSTRAINTS

In addition to the TSCA regulations, the UE-FFCA, DOE orders, and other guidelines discussed in Section 3 of this assessment, there are constraints of a "policy" nature that may affect the project. These constraints are identified in this section but were not considered in the evaluation of alternatives because of the relative difficulty in predicting the effect they may have on the project outcome.

The most obvious constraint is the "moratorium" currently imposed on off-site waste shipments from DOE facilities. The events leading to the imposition of the moratorium, and the local interpretation of the interim guidance provided in the Objective, have created an atmosphere in which Energy Systems officials may not be inclined to sign the certifications necessary to institute off-site waste shipments. This disinclination is understandable in light of subsequent litigative actions.

The legal implications of off-site release are major concerns to Energy Systems. These are fully discussed in Section 8.1.1.

Energy Systems has prepared and implemented a standard entitled "Management of Polychlorinated Biphenyls (PCBs)," ESS-EP-125, Rev. 1, July 28, 1992 (ref. 8). The standard serves as a supplement to TSCA and a guide for developing site-specific procedures. The standard is designated "For Internal Use Only" and has the following Performance Objectives:

1. To comply with all federal, state, and local requirements regarding the management of PCBs.

2. To dispose of all transformers that contain detectable levels of PCBs through total destruction. Energy Systems uses the total destruction method of disposal, which eliminates the need to place waste items such as transformer carcasses in a landfill. This method may include a combination of incineration, dechlorination, decontamination, and smelting to eliminate any residual PCBs.

3. To minimize the potential CERCLA and civil liabilities regarding the use, handling, storage, and disposal of PCBs.

4. To phase out all PCB articles regulated by federal and state law to the maximum extent practicable in as short a time as possible.

The current SEG size and regulatory limitations may also influence future policy-making decisions. For example, if the transformers cannot be demonstrated to be free of PCB contamination, if SEG is unsuccessful in obtaining TSCA licensing, or if other states will not accept contaminated transformer shipments, the desirability of constructing an on-site treatment facility increases. On the other hand, small transformers could be processed at SEG (if they obtain TSCA licensing), and the larger transformers could be either processed at SEG (assuming resolution of size problems) or sent to another vendor. In the latter case, the desirability of constructing an on-site treatment facility decreases.

With regard to Alternative 3, any bias that may exist in favor of constructing new facilities on the ORR in order to accommodate future needs is offset by the low number of new PCB transformer wastes being generated. As discussed in Section 7.1.3, a number of different on-site treatment schemes have been considered for this project; however, DOE's move toward privatization (where the capability exists in the private sector) might also be a factor in dealing with this bias.

In summary, both DOE and Energy Systems embrace the following policies, all of which support this assessment's recommendation to implement Alternative 1 where possible:

- maximization of resource recovery and recycling,
- minimum depletion of landfill capacity (both on- and off-ORR),
- minimization of long-term liability,
- cost-effectiveness, and
- promotion of privatization (as mentioned above).

6.0 ANALYSIS OF VENDOR CAPABILITIES

As part of this study, four vendor facilities were visited and assessed to determine the available technologies to be considered for off-site treatment and disposal of the transformers. None of these vendors were interested in obtaining an NRC license. All stated that the technical aspects of obtaining a license were trivial compared to the political difficulty. The various processes used at the facilities are summarized in ***Table 6.1***. Vendor literature is provided in ***Appendix A***.

Table 6.1. Vendor Capabilities

Vendor	Incinerator	Solvent Wash	Disassembly	Remote Incineration	Landfill
EPS	Yes	N/A	Yes	Yes	N/A
SD Myers	N/A	Yes	Yes	Yes	Yes
UNISON	N/A	Yes	Yes	Yes	Yes
Aptus	Yes	Yes	Yes	N/A	Yes

6.1 ENVIRONMENTAL PROTECTION SERVICES

EPS, of Wheeling, West Virginia, operates two process lines in an industrial area immediately adjacent to a rail spur, providing excellent transportation links. One line uses a smaller furnace and handles mercury-contaminated gas meters. The other line uses a large furnace to decontaminate PCB equipment via thermal desorption. Currently, EPS accepts only transformers containing less than 500 ppm PCB, because they do not have a permit from EPA for incinerating items with a higher concentration of PCBs (both undrained and drained). By avoiding the need for this permit, the facility operates under a West Virginia air-quality permit. According to EPS, the additional expense of an EPA permit is not justified considering the limited market for disposal of transformers with PCB concentrations greater than 500 ppm, although the facility's process would handle any concentration of PCBs used in transformers. The facility focuses on complete and documented destruction of the transformer on site, with no identifiable components, solvents, or residues leaving the site as waste. Transformer fluid containing between 50 and 500 ppm PCB leaves the site for detoxification at a TSCA-permitted facility. EPS provides a certificate of destruction, as does the TSCA-permitted detoxification facility.

Although EPS does not directly provide transportation services to its clients, it can provide such services through independent waste haulers with all necessary DOT licenses. Clients may also arrange for shipment on their own. Once a transformer enters the facility, it is bar-code tagged. Any remaining fluid is decanted, the tops of the cans are removed, and the entire transformer, either as a unit or as components, is heated to a high temperature in a furnace. The large down-draft furnace exhausts into an afterburner fueled by a combination of natural gas and transformer fluid. Residence times of at least 2 s, aided by a minimum of 3% excess oxygen, assure the TSCA-mandated 99.9999% destruction of PCBs. Following incineration, a shaker table separates the majority of the ash resulting from combustion of paint, paper, and other combustibles. All constituents are then completely disassembled by hand. The resulting materials are disposed of as follows:

1. Steel transformer cans are broken up at the facility and shipped directly to a smelter.

2. The actual cores are disassembled into copper windings and silicon steel and also shipped directly to a smelter.

3. Ceramic bushings are shipped to a road materials firm where they are crushed and used to supplement asphalt-based road materials.

4. The ash contains significant amounts of copper and is sold to a smelter for recycling.

5. Fluids containing less than 50 ppm PCB serve to fuel the furnace afterburner.

6. Fluids containing 50 ppm - <500 ppm PCB are shipped to a TSCA-licensed facility for detoxification.

No components are placed in landfills. All constituents are either recycled or consumed.

6.2 S. D. MYERS

6.2.1 Overview

SDMI is based in Tallmadge, Ohio, and uses a solvent-wash system for decontaminating transformers after disassembling them for recycling. SDMI's primary facility occupies a 188,000-ft^2 building housing the plant area, offices, and laboratory. Process lines on site include those for destruction and disposal of transformers and electrical equipment; dechlorination of transformer fluids; repair and remanufacture of electrical equipment; and disposal by recycling of PCB-contaminated lead cable, capacitors, light ballasts, and gas meters, as well as laboratory and analytical services, research and development, and equipment manufacture. SDMI owns and operates approximately 65 vehicles to transport hazardous and PCB wastes, including PCB-contaminated transformers and fluids.

SDMI operates several EPA-approved process lines with registered trade names. Three of these have potential application to the K-25 transformer disposal operation: Resource Recovery®, Material Recovery®, and PCB-Gone®. Resource Recovery® operations treat regulated (≥ 450 ppm PCB, if drained) equipment. Material Recovery® operations treat unregulated (< 450 ppm PCB, if drained) equipment. PCB-Gone® dechlorinates PCB transformer fluids.

6.2.2 Resource Recovery® - Regulated Transformer Processing

Resource Recovery® operations decommission electrical equipment, destroying the contained PCBs and recycling the metal and ceramic components. The process is not limited by PCB contamination levels or fluid type. Upon arrival at SDMI, equipment is unloaded indoors into a diked process area. All subsequent operations (up to documentation that the equipment is clean) take place within this area. The units are drained into bulk storage even if they have been previously drained, thereby assuring that all free-flowing liquids are removed. The units are then flushed with solvent to remove gross amounts of PCBs. Processing continues with the removal of transformer lids and manual separation into components, resulting in:

Paper, wood, and other cellulose materials
Copper or aluminum windings
Steel case
Gauges, fittings, and structural steel
Silicon steel laminations
Ceramics from bushings and insulators

Cellulose materials and PCB residues and bottoms from solvent recycling are disposed of in an off-site, TSCA-permitted PCB incinerator with SDMI listed as generator. Fluids with >5000 ppm PCB received in transformers are also disposed in this manner, but the sender (in this case, Energy Systems) is listed as the generator of such fluids. Fluids with < 5000 ppm PCB are dechlorinated by the PCB-Gone® process described in Section 6.2.4. Metals and ceramics are separated into general categories by composition and subjected to a proprietary solvent washing. The cases are separated. All materials that are solvent washed are tested using standard wipe samples and must be documented as clean to less than 10 μg PCBs per 100 cm^2 of surface area. All metals are processed to appropriate forms, including the cases, for smelting, and are shipped directly to smelters, thus avoiding any scrapyard middlemen. Ceramics are crushed and sent to a road-bed materials operation for incorporation into highways.

A detailed mass balance is maintained on all equipment and materials. The weight of each component, as well as the final cleanliness documentation, is reported on the Certificate of Destruction (or Certificate of Recycling) that SDMI issues.

6.2.3 Material Recovery® - Unregulated Transformer Processing

Material Recovery® processing roughly parallels that of Resource Recovery®. Units are first moved to a separate diked area, outside the Material Recovery® line, during verification that current and valid PCB test results are present. If not, the units are tested prior to further processing. Any unit testing > 450 ppm PCB is not processed by Material Recovery®. The 450-ppm figure is used to allow for a 10% variance in test results. All fluid is drained, categorized, and moved to a mineral-oil-processing and disposal area. Most frequently, the fluid is dechlorinated in the PCB-Gone® line described in Section 6.2.4. The fluid can also be dechlorinated at other vendor facilities or incinerated. Transformers are separated into components as described for the Resource Recovery® line and mechanically cleaned and dried of residual fluid. PCBs and other non-recyclable components are destroyed. Aluminum and copper from the windings are separated and prepared for recycling by chipping. Laminations, tanks, and ceramics are also reduced in size for recycling. Certificates of destruction are issued for fluids and for loads of equipment. Rather than individual testing of each piece of equipment, Materials Recovery® relies upon EPA-approved statistical testing to continuously demonstrate the effectiveness of the process.

6.2.4 PCB-Gone® - Dielectric Fluid Dechlorination

PCB-Gone® is a permitted, proprietary process for dechlorinating dielectric fluids containing up to 5000 ppm PCB. In practice, the total blend is modified to assure that 5000 ppm PCB is not exceeded. The process results in a reusable dielectric fluid. The process line is contained within a diked and controlled process area. PCB concentrations in the resulting fluid are less than 2 ppm PCB.

6.3 UNISON

UNISON, Inc., is a wholly owned subsidiary of Union Carbide Chemicals and Plastics Company, Inc., and operates a process line for the decommissioning of PCB transformers and capacitors in Ashtabula, Ohio. UNISON's transformer destruction process is registered as TRANS-END®. UNISON maintains a dedicated truck fleet that transports customers' transformers. Alternatively, customers may deliver transformers to the facility via a licensed hazardous-waste hauler.

Upon receipt, transformers are logged into a tracking system prior to being deposited in the diked processing area. The transformers are pumped to remove any residual free liquids. In the first processing step, the cover and bottom valves are removed and a small hole is cut into the tank floor. The transformers are hoisted by an overhead lift into a primary cleaning tank and solvent washed. After washing, the transformers are dried to remove the solvent, a crucial step that greatly reduces the potential for contamination of the teardown area.

In the second step, the dry transformer is moved to a teardown area and completely disassembled. Metallic components are segregated by type and placed into containers for further cleaning. Embossed metal identification tags are attached to each container for positive identification. Transformer cases are reprocessed through the primary cleaning cycle until decontaminated. All identifiers are ground off, and the case is removed by a recycling company.

The other metallic components are cleaned with solvents several times. After cleaning, the metal containers are put into a holding area and affixed with yellow tags indicating that the results of wipe sample analysis are pending. When analytical results are received indicating successful decontamination (less than 10 μg per 100 cm^2 of surface area), green tags are affixed, and the metals are sent out for smelting.

Combustibles, including solvent bottoms, PCBs, paper, and wood, are shipped to a TSCA-licensed incineration facility. Complete removal of combustible insulation from windings is achieved through a proprietary process. Ceramics are also cleaned and recycled.

Once the transformers are destroyed, UNISON provides each customer with:

1. a signed copy of the original manifest indicating waste removal from the Ashtabula site issued within 30 days of receipt of the shipment,

2. a Certificate of Disposal for each transformer when teardown is completed, and

3. a Certificate of Disposal for each manifest when all manifested combustible materials have been incinerated.

6.4 APTUS

Aptus, Inc., operates a comprehensive, PCB-equipment disposal facility on a 66-acre site outside Coffeyville, Kansas. The operation is largely housed in aircraft hangers and has been in operation since 1986. Relevant process lines include PCB and hazardous waste transportation, transformer decommissioning, transformer drain and flush, chemical detoxification, solvent recovery, and TSCA/RCRA incineration.

6.4.1 PCB and Hazardous Waste Transportation

Aptus owns and operates a fleet of licensed and permitted vehicles for industrial wastes, including van trailers, flatbeds, dropdecks, transformer fluid reclaimers, and vacuum tank trucks. The vehicles are equipped with seamless metal containment pans designed to contain any leakage from PCB items during transport. All drivers are trained Aptus employees. A satellite tracking system allows 24-h communications and location monitoring to within 1000 ft anywhere within the U.S.

6.4.2 Transformer Decommissioning

Transformer decommissioning at Coffeyville has been underway since 1989 using a solvent-cleaning and dismantling process. The process line lies within a bermed containment area. Once the contamination level is confirmed, transformers from a bermed storage area are drained, perforated to allow solvent flow, flushed with solvents, and then dismantled in a controlled-air building. Once dismantled, the components are moved to either a vapor boil box or a vapor degreaser tank for final cleaning. Verification is performed through wipe testing, and a reading of below 10 μg per 100 cm^2 of surface area allows off-site release of the transformer components.

Core laminations and windings are separated and shipped to recyclers. The transformer cases are shipped intact. Non-metal components are incinerated on site as described in Section 6.4.6. Solvents are recovered as described in Section 6.4.5.

6.4.3 Transformer Drain and Flush

Aptus began transformer drain-and-flush operations in 1984. This process does not handle transformers with 500 ppm or greater PCB. The operation takes place on a drain platform within a bermed containment area. Transformers are drained, then filled with 1,1,1-trichloroethane. The solvent remains in place for a minimum of 18 h [per 40 CFR 761.60(b)(1)(i)(B)]. The solvent is then drained and transferred to the solvent recovery process described in Section 6.4.5. After approximately 5 h of air drying, absorbent material is added to each unit prior to shipment to a TSCA-approved chemical waste landfill for disposal.

6.4.4 Chemical Detoxification

The Aptus chemical detoxification process was first demonstrated in 1986. Currently, the process is permitted to chemically treat transformer fluid containing PCBs up to 4100 ppm. Elemental sodium in an organic solvent is added to the PCB dielectric fluids in a large tank. The chlorine atoms are stripped from the PCB, forming sodium chloride and biphenyl. This is known as the Goodyear process or the Wurtz reaction. The dechlorinated mineral oil is sold as fuel. The residual salt water is either passed through an incinerator to remove trace organics or processed through a wastewater treatment facility and recycled.

6.4.5 Solvent Recovery

The solvent recovery process began operation in 1986. Currently, the process is permitted to distill 1,1,1-trichloroethane solvent contaminated with PCBs in concentrations up to 118,000 ppm. The non-thermal solvent distillation separates PCBs in a closed loop through a distillation column. PCB fluid is separated and collected as still bottoms and then transferred to the on-site incinerator for disposal. Recovered solvent (<2 ppm PCB) is reused in treatment.

6.4.6 TSCA/RCRA Incineration

The TSCA/RCRA incinerator began operations in 1986. Currently, the incinerator is permitted to treat RCRA/PCB-contaminated liquids, solids, and sludges. The thermal treatment process consists of a 61,900,000-Btu/h rotary kiln equipped with an afterburner chamber and air pollution control train incorporating a spray dryer, baghouse, saturator, and ionizing wet scrubbers for acid gas and particulate removal. Destruction and removal efficiency is in excess of 99.9999% for PCBs and 99.99% for RCRA wastes to comply with 40 CFR 761.70(b)(1) and 264.343(a)(1), respectively.

7.0 EVALUATION OF ALTERNATIVES

The alternatives considered for treatment and disposal of the K-25 transformers fall into three major categories. The first alternative applies to transformers that have been defined as either nonradioactive or not radioactively contaminated by DOE operations, and is unrestricted off-site release to a commercial facility for further processing. This approach thus avoids requirements associated with shipping radioactive waste. The second alternative is off-site release as PCB/radioactive waste. This approach does not appear feasible because of the unwillingness of commercial vendors to obtain permits allowing PCB/radioactive waste shipment to and treatment at their facilities. The third alternative, on-site treatment, requires construction of a facility for the PCB and radioactive decontamination of the transformers. The remainder of this section addresses the technical feasibility, relative cost, and schedule implications of these three general alternatives. Overall decision flow charts are provided in ***Figures 7.1****,* *7.2,* and *7.3.*

7.1 TECHNICAL FEASIBILITY

Most of the components making up the transformers are valuable and marketable on the secondary metals market. Materials potentially resulting from transformer decommissioning may be recycled or disposed of as listed in ***Table 7.1.***

Table 7.1. Materials Disposition

Type of Transformer Material	Typical Disposition
Copper	General industrial metal
Aluminum	General industrial metal
Silicon steel	Industrial metal for transformer production
Structural steel	General industrial metal
Ceramics	Added to road base
Combustible paper and wood	Incinerate
PCB-contaminated solvents and still bottoms	Incinerate
Nonradioactive ash	Copper recovery
Radioactive ash	Dispose of as radioactive waste
Paint residue	Dispose of as hazardous waste

7.1.1 Alternative 1: Off-Site Release as Nonradioactive Waste

According to the Objective, transformers can be released off site as nonradioactive waste if they are not contaminated from DOE operations. For a given transformer, this can be demonstrated in one of three ways:

1. Alternative 1.1: RMMA Criterion

   If it can be certified that the transformer originated outside a designated RMMA (as defined in Section 4.3 of the Objective), the transformer may be released without further survey.

2. Alternative 1.2: Survey

   If the transformer originated within an RMMA, contamination could exist inside and/or outside the case. As discussed in Section 2.1.2, fluids from the K-25 transformers appear to contain levels of radioactivity that are not appreciably greater than those in commercial transformer fluids (although additional S&A and data-evaluation efforts are needed).

   The nature and extent of external contamination should then be determined as described in Section 4.2 of this assessment.

3. Alternative 1.3: Simple Decontamination

   If the survey shows surface contamination, Energy Systems may choose to decontaminate the transformer on site. Following decontamination, the transformer should be resurveyed to either document a reduction in contamination sufficient for off-site release (as in Alternative 1.2 above), or reveal fixed contamination requiring more rigorous treatment (see Section 7.1.3, Alternative 3).

4. Alternative 1.4: Paint Removal

   As stated in Section 4.2, coats of paint on transformers in addition to the original factory paint, can effectively shield surface radiation from detection, especially if the paint is lead based. In light of the service lives of the subject units, post-factory painting is extremely likely. Energy Systems may elect to remove some or all of the paint prior to off-site release. This can be done using one or more of the methods described in Section 7.1.3, Alternative 3.3. Following paint removal, the transformer should be resurveyed.

Assuming successful implementation of Alternatives 1.1, 1.2, or 1.3, the transformer can be released to an off-site facility. Shipment criteria recommended by this feasibility assessment then become a function of the PCB content of the transformer's drained fluids, and are as follows:

- <50 ppm. Shipment off site as a non-PCB transformer

- 50 ppm-<500 ppm. Shipment to a licensed commercial whole-unit incineration facility (e.g., EPS)

- ≥500 ppm. Shipment to a TSCA-licensed commercial solvent-washing facility

Alternatives 1.1, 1.2, and 1.3 are entirely feasible both from regulatory and technical viewpoints. Energy Systems internal procedures and requirements might require modification to match federal and DOE regulations and guidance. Some transformers may require further treatment, but the majority could be disposed of using commercial vendors under Alternative 1.

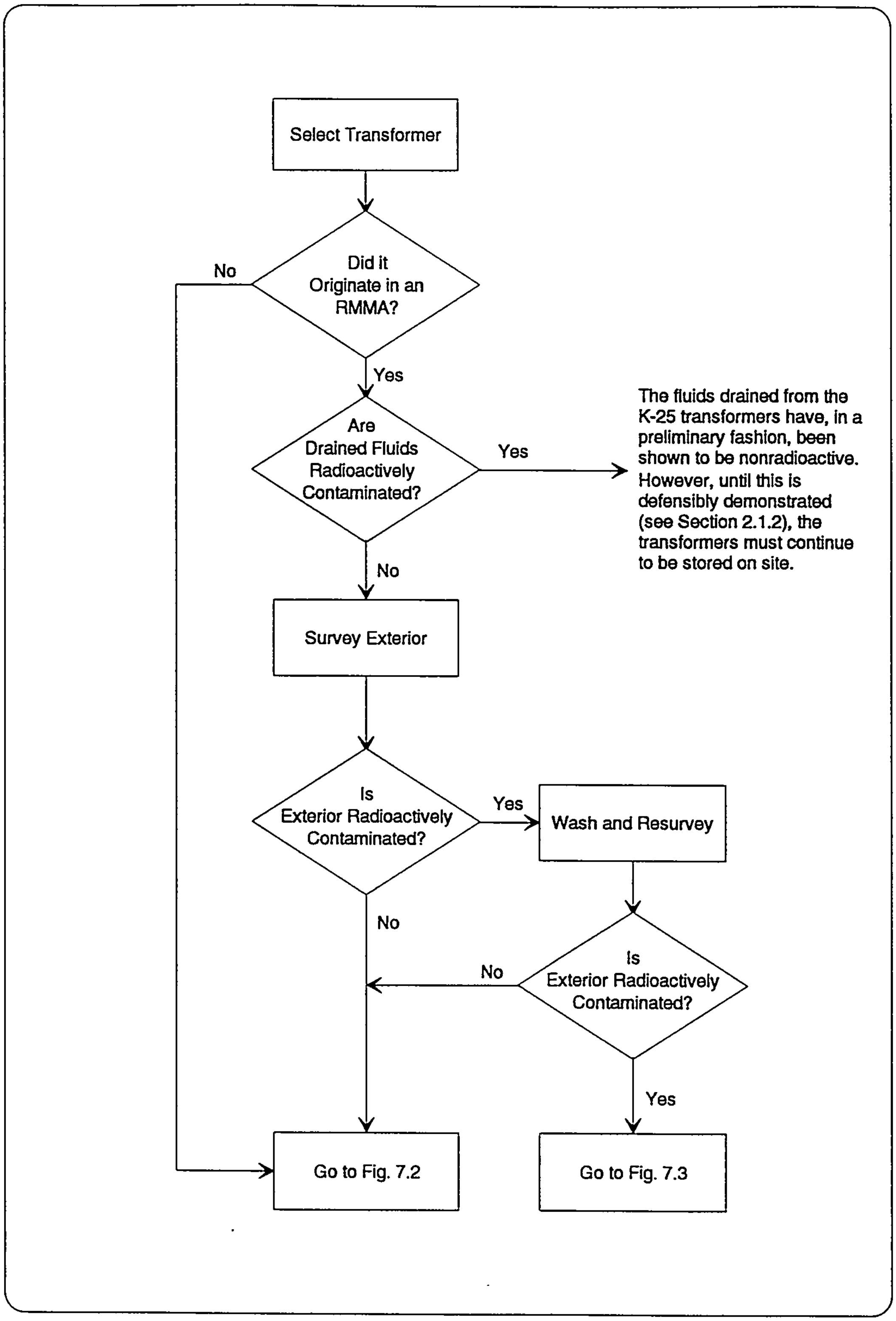

Fig. 7.1. Disposition of K-25 transformers.

PAI REV. 12-01-93
DISPK25.DRW
DISK: NELSON-1

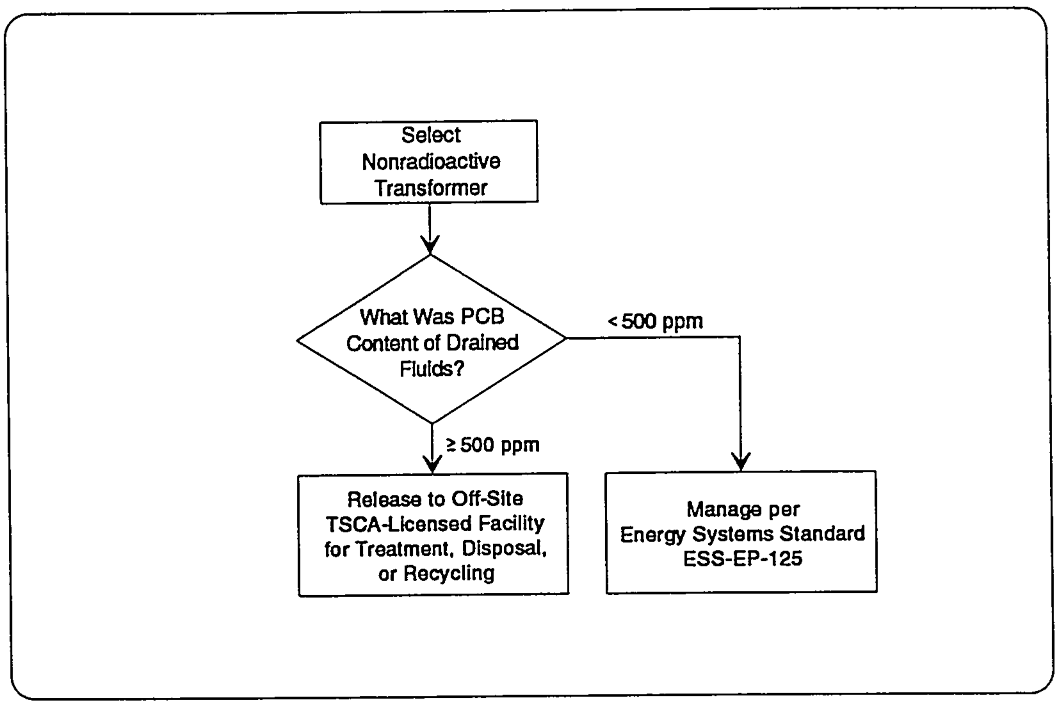

Fig. 7.2. Disposition of nonradioactive transformers.

PAI REV. 12-01-93
DISPK25.DRW
DISK: NELSON-1

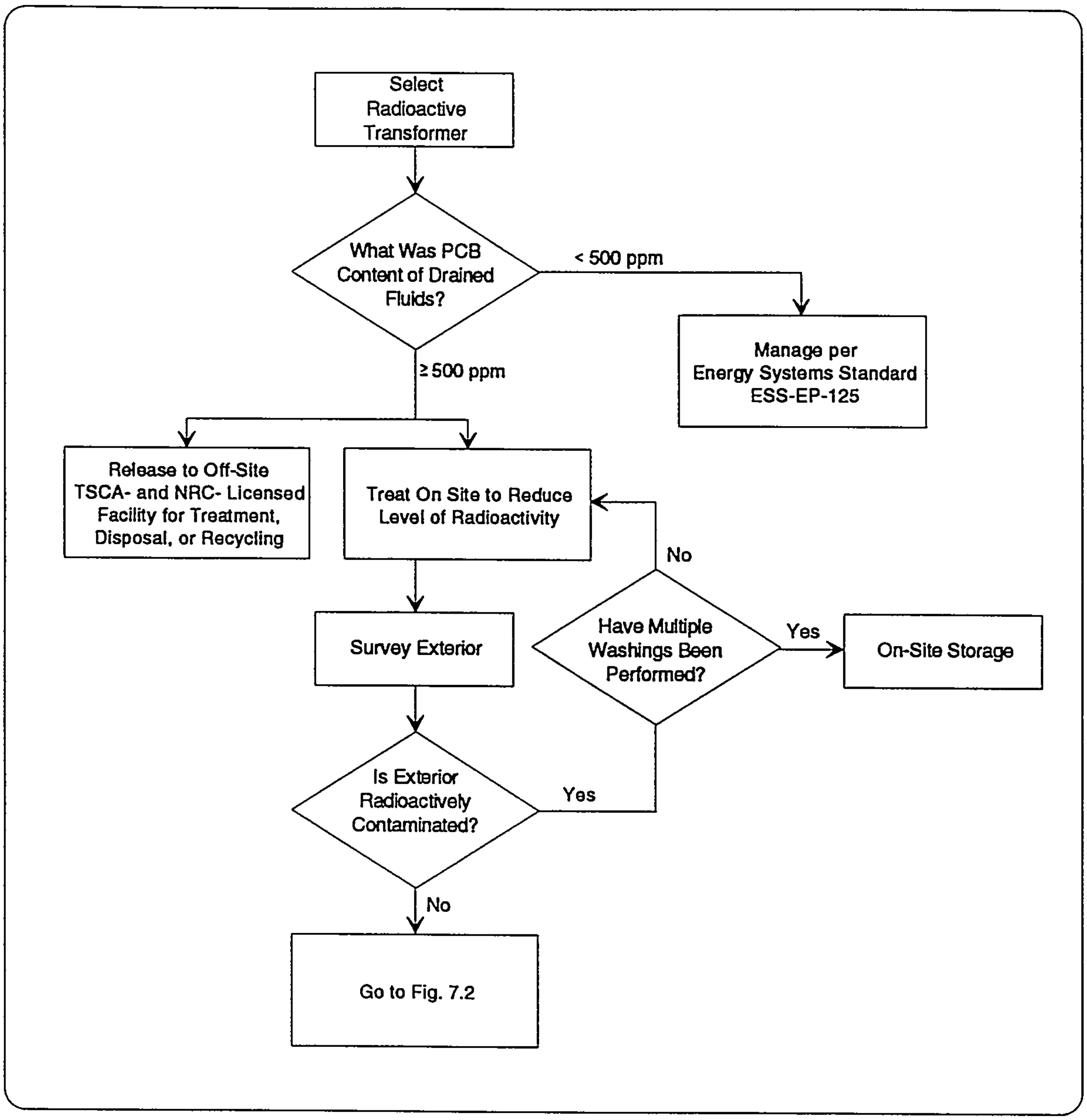

Fig. 7.3. Disposition of radioactive transformers.

PAI REV. 12-01-93
DISPK25.DRW
DISK: NELSON-1

7.1.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

None of the four vendors contacted is licensed to receive transformers classified as PCB/Radioactive waste. None is willing to obtain an NRC license to receive such waste. This alternative is not viable now because no commercial facility satisfies the dual requirement of TSCA and NRC licensing or uses processes designed to accommodate PCB/radioactive waste. This alternative will become viable if and when a vendor becomes both TSCA- and NRC-licensed (e.g., SEG; see Section 2.2.2).

7.1.3 Alternative 3: On-Site Treatment

On-site treatment may be required for some transformers even if Alternative 1 is successful for most. On-site treatment may be directed at reducing the levels of PCBs, radioactive contaminants, or both. On-site disposal and recycling options include whole-unit incineration, disassembly and incineration, solvent-wash decontamination, mixed incineration and solvent-wash decontamination, conversion, size reduction for metals recycling, and incineration for combustible component disposal. This assessment does not consider use of ORR landfills as a viable alternative for disposal of any of the subject transformers, regardless of their levels of PCB or radioactive contamination (see Section 1).

1. Alternative 3.1: Whole-Unit Incineration

   Whole-unit incineration has been demonstrated by the EPS system for PCB decontamination, but has not been demonstrated to be effective at radioactive decontamination. Whole-unit incineration involves placing the transformer with the top removed into a large furnace, firing the furnace, and running the exhaust through a secondary burner to destroy PCBs. Technical aspects of removing radioactive constituents from contaminated transformers prior to or after incineration remain. Key elements required for on-site incineration include:

   - the physical incineration facility,
   - PCB-transformer decommissioning permit,
   - Tennessee air-pollutant emission permit,
   - EPA/TSCA PCB incinerator permit for PCB concentrations greater than 500 ppm,
   - EPA/DOE UE-FFCA for incineration of radioactive materials, and
   - buyers for the recycled materials.

   Incineration is demonstrably capable of destroying PCBs in the transformers with a minimum of pre-treatment disassembly; however, the applicability of the technique to radioactive decontamination is not known and would require significant research and experimentation.

   Incineration faces significant regulatory difficulties. Both the EPA and the state of Tennessee currently have moratoriums on permits for the incineration of hazardous wastes. A whole-unit incineration technique may be effective in removing fixed radioactive contaminants because paint is removed, but the effectiveness and efficiency of this process is unknown. Difficulty in negotiating an additional permit for the incineration of radioactive materials is also expected. A system for removing radioactive materials from the incinerator exhaust has been developed for the existing TSCA incinerator at K-25. Systems for removing the radioactive constituents from the other waste streams will require development. Given the moratoriums, the generally negative public response to incinerators, and the technical uncertainties associated with the design and construction of a large PCB/radioactive-waste incinerator, this alternative does not appear feasible.

2. Alternative 3.2: Disassembly and Incineration

Disassembly of the units followed by incineration of the components offers the advantage of a smaller furnace if the transformer cases can be cut up prior to incineration. While combustibles may be handled by the existing TSCA incinerator, the cases and other metallic components are unlikely to be suitable for the existing incinerator unless processed into metal chips. Using the existing incinerator with metal chips or constructing a smaller furnace may offer significant capital cost savings over construction of a large furnace. More extensive contamination control during disassembly and the need to cut large units into manageable sizes could significantly increase operating costs. Use of the existing incinerator with metal chips would result in a slag of various metals which may remain radioactively contaminated, thus reducing the material's desirability for recycling and generating more nonrecyclable waste.

3. Alternative 3.3: Solvent-Wash Decontamination

Three of the four vendors visited as part of this study use solvent-wash decontamination for PCB removal. All three use a similar process that has been demonstrated and approved to remove PCBs:

- Drain remaining fluid.
- Remove top and perforate case to allow free drainage.
- Rinse entire unit with solvent.
- Manually disassemble unit into steel case, silicon-steel core, copper or aluminum windings, combustibles, and ceramics.
- Solvent-wash components.
- Sample to determine PCB level.
- Release metals and ceramics for recycling.
- Incinerate combustibles on-site or at subcontractor facility.

Key elements required for on-site application of the solvent-wash decontamination technique include:

- The physical facility.
- Tennessee air contaminant emission permits for various process units, and
- EPA permits for PCB processes (e.g., PCB solvent recovery; PCB transformer decommissioning permit).

While the effectiveness of these specific processes for radioactive decontamination has not been demonstrated, solvents that dissolve paint would remove fixed surface contamination along with PCBs. One additional solvent wash for cases and any other painted materials, plus post-treatment radiological screening, would probably be sufficient. Alternatively, a non-solvent decontamination step could be introduced into the process, such as the ICE BLAST™ process developed by Applied Radiological Control, Inc. This innovative Crystalline Ice Blasting system was originally developed for paint removal from aircraft. ICE BLAST™ has been shown to be effective in a wide variety of cleaning applications including stainless steel, carbon steel, fiberglass, rubber, concrete, plastic, lead, copper, aluminum, and other coated materials. ICE BLAST™ utilizes low-pressure air and wet ice for cleaning and surface preparation. The compressed air and ice chips readily clean and remove both fixed and loose radioactive contamination through the process of crack formation and propagation. ICE BLAST™ is attractive due to its avoidance of organic solvents and its relatively low waste-generation rate (i.e., approximately 24 gal of wastewater/h). The development and installation of some hybrid system on the ORR appears technically feasible. It should be possible to obtain permits for the PCB processes and the air contaminant emissions.

Alternatively, any of the vendor solvent-wash systems remove PCBs. Transformer components still exhibiting radioactivity following treatment could be either disposed of as low-level radioactive waste or recycled at the SEG facility in Oak Ridge.

4. Alternative 3.4: Mixed Incineration/Solvent-Wash Decontamination

   Incineration and solvent-wash techniques could be blended in a single process line. Solvent-wash systems already rely upon incineration for the disposal of combustibles and PCB-containing liquids. No advantage appears to exist for using a combined system that requires additional PCB incineration permits. Using the on-site TSCA incinerator provides an obvious component of a mixed system already discussed above.

5. Alternative 3.5: Alternate On-Site Treatment Methods

   TSCA regulations [40 CFR 761.30(a)(2)(v)] allow the "conversion" of PCB transformers as a means of reclassification; the process is described in Section 3.1.2 of this assessment. Conversion is probably not a viable alternative for the subject units due to age, condition, and being out of service.* Moreover, conversion of transformers whose fluids contained greater than 500 ppm PCB has often been unsuccessful. At least one vendor, SDMI, no longer attempts conversion of such transformers.

   Upon approval by the Director of EPA's Exposure Evaluation Division, alternative treatment methods are allowed that could be more viable for the subject transformers. Energy Systems (with the possible involvement of selected vendors) may choose to pursue an alternative on-site process similar to conversion, which does not require re-energizing the units. This might consist of refilling the units with non-PCB fluids, heating to a predetermined temperature for a period of time, measuring the fluid's final PCB concentration, and repeating the process as necessary. This alternative method could conceivably reduce PCB levels to the non-PCB transformer level, allowing either unrestricted release or release as radioactive waste only.

7.2 COST

Listed below are preliminary cost estimates for certain portions of the work necessary to dispose of the transformers. The estimates compare the three alternatives and are not intended to represent total disposal costs or to be used for budgetary purposes. On-site transportation costs, overhead costs, testing and survey costs, and other costs similar for any alternative are not estimated.

*Specifically, the units were drained more than 2 years ago. As a result, the electrical windings can no longer be safely energized due to deterioration of the insulation, and all gaskets and seals will have dried out and possibly cracked. Any attempt to refill and re-energize the transformers could result in oil leaks and/or serious threats to personnel safety.

7.2.1 Alternative 1: Off-Site Release as NonRadioactive Waste

In general, costs for transformer management by off-site vendors are relatively low because the vendor typically takes ownership of the transformer and sells the raw materials. For example, EPS does not charge major clients who send large transformers for disposal if the transformers are delivered to their facility. EPS makes their profit largely from resale of the scrap metal. Aptus charges approximately \$0.56/lb for transformers with fluids containing <500 ppm PCB and \$0.85/lb for transformers with fluids containing ≥500 ppm PCB. S. D. Myers charges from \$0.10/lb to \$0.60/lb, not including fluid disposal. Costs associated with the off-site release alternative increase slightly through the three subalternatives. The cost elements for Alternative 1 include:

- Alternative 1.1: RMMA Criterion:
  - Packaging and loading
  - Shipping
  - Processing

- Alternative 1.2: Survey:

  Add the following additional step:

  - Survey and documentation

- Alternative 1.3: Simple Decontamination:

  Add the following additional steps:

  - Transport to washdown area
  - Washdown
  - Resurvey

This approach may well handle all transformers involved. If this is the case, then this will be the least expensive approach. Assuming an overall cost of approximately \$1/lb based on the vendor estimates noted above, the total processing cost would be approximately \$1,400,000. Additional costs would include on-site costs for packaging, loading, shipping, surveying, and decontamination.

7.2.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

While this alternative is not viable at present (see Section 7.1.2), the cost is expected to exceed that of Alternative 1 due to the premium rates anticipated from TSCA- and NRC-licensed shipping, treatment, and disposal firms.

7.2.3 Alternative 3: On-Site Treatment

The costs of on-site treatment involve capital outlays not required for Alternative 1. These outlays depend greatly upon the nature of the treatment. Essentially the elements involved in an on-site facility include:

Facility design
Facility permitting
Facility construction
On-site packaging and transportation
Processing cost
Recycled materials shipping
Receipts from sale of recycled materials

Alternatives 3.1 and 3.2 involve the construction and permitting of a new, on-site incineration facility. According to EPS, the construction of a large-furnace facility from the ground up would cost approximately $2,000,000. Based on previous experience with similar projects, such construction at a DOE facility by an outside contractor (as envisioned by Energy Systems) could conceivably cost at least twice that amount. Based upon EPS's statement that they frequently charge little or nothing for the incineration because they recover their costs from the sale of scrap, the overall operating costs may be offset by the sale of recyclable materials. The largest uncertainty lies in the cost of obtaining a TSCA permit for a new incinerator.

An estimate of the costs of treating the transformers on-site and recycling the uncontaminated components using a new incinerator follows.

Table 7.2 Cost Estimate for On-Site Incineration and Recycling

Item	Cost ($)
Design and Permitting	700,000
Construction Cost	4,000,000
Contingency at 40%	1,600,000
Treatment cost estimated at $.50/lb	700,000
Cost recovery from recyclable sales	-700,000
Demobilization	1,000,000
TOTAL COST	$7,300,000

The above estimate does not include costs for packaging and loading, survey and documentation, or treatment of radioactive contamination. Such costs should be similar to the cost of these same items under Alternative 1, which were not included in the $1,400,000 processing cost for Alternative 1. Shipping costs required for Alternative 1 would be avoided in this alternative, provided that recycling revenues cover those costs.

Alternative 3.3, solvent-wash decontamination, involves the same steps as incineration without requiring an EPA PCB incinerator permit, thus significantly reducing cost uncertainty. Costs for Alternative 3.4, mixed incineration/solvent-wash decontamination, should be similar to those for pure solvent wash, depending upon the type of incineration planned.

The costs for plant construction and disposal of the transformers for either Alternative 3.3 or 3.4 would be greater than for Alternative 1. SDMI estimated that construction costs for a solvent-wash facility would be approximately $5,000,000. Again, construction at a DOE facility could be double that amount or more. SDMI recommended that the plant be designed to process 25,000,000 lb of transformers under the assumption that, for the capital investment required, it would be appropriate to treat ORR, Portsmouth, and Paducah transformers. SDMI estimated a treatment cost of $15,000,000 for those units, or \$0.60/lb. An estimate of the costs of treating the transformers on site and recycling the uncontaminated components using a new solvent-wash facility follows.

Table 7.3 Cost Estimate for On-Site Solvent Washing and Recycling

Item	Cost (\$)
Design and Permitting	700,000
Construction Cost	9,000,000
Contingency at 40%	3,600,000
Treatment cost estimated at \$.70/lb	980,000
Cost recovery from recyclable sales	-700,000
Demobilization	1,000,000
TOTAL COST	\$ 14,580,000

The above estimate does not include costs for packaging and loading, survey and documentation, or treatment of radioactive contamination. Again, those costs would be similar to Alternative 1, although Alternative 1 would most likely have additional shipping costs.

Aptus indicated no interest in constructing a facility. UNISON is willing to build, but requires specific information to provide an estimate.

An alternative method, such as Alternative 3.5 described in Section 7.1.3, could prove to be the least expensive approach to on-site treatment. This approach could be coupled with removal of exterior contamination (see Section 7.1.1, Alternative 1.3) and/or paint removal (see Section 7.1.1, Alternative 1.4) as necessary. If this route is chosen, its costs must be added to the costs for off-site shipment as described in Section 7.1.1.

If the majority of the transformers have been released through application of Alternative 1 and only a few require further processing, then construction of a complete facility would almost certainly prove too costly; local treatment for either radioactive or PCB contamination would be required. Pressure washing or *in situ* paint removal can probably be performed at the current transformer locations, if appropriate precautions are taken.

7.2.4 Cost Analysis

Alternative 1 remains the least expensive alternative because the systems to transport, decommission, and recycle the transformers already exist and have been developed in a competitive environment. The most cost-effective system is to dispose of transformers as follows:

- <50 ppm. Shipment off-site as a non-PCB transformer
- 50 ppm-<500 ppm. Shipment to a licensed commercial whole-unit incineration facility
- ≥ 500 ppm. Shipment to a TSCA-licensed commercial solvent-washing facility

7.3 SCHEDULE

Because of the uncertainties inherent in dealing with PCBs and possible radioactive contamination at a DOE facility, the current moratorium on shipping wastes to commercial facilities, and the regulatory challenges for some alternatives, developing an accurate schedule for treatment and disposal of the transformers in question is not possible. Durations of key activities are discussed below for the purpose of comparing the three alternatives.

7.3.1 Alternative 1: Off-Site Release as NonRadioactive Waste

No schedule for off-site release has been developed for this report. The large-scale vendors are set up for a rapid turnaround. The single, most time-consuming aspect of this alternative will probably be the development and implementation of the S&A efforts described in Section 2.1.2. If all transformers are certified free of radioactive contamination, they could be disposed of within a matter of months with maximum efficiency provided by using a one-stop service such as Aptus or SDMI, where packing, loading, shipping, and disposal are handled by dedicated contractor personnel. EPS estimated a two- or three-month duration for processing the 1.4 million lb of transformers in question.

7.3.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

This alternative is not considered feasible. It would probably take a number of years for a commercial facility to obtain both NRC and TSCA permits, let alone design and construct a decontamination process line. As stated in Section 2.2.2, none of the vendors contacted has a current interest in obtaining an NRC license.

7.3.3 Alternative 3: On-Site Treatment

The key uncertainty in developing on-site treatment capabilities is the permitting schedule. If a new incinerator is required, the permitting process would take a number of years with no guarantee that a permit would be issued based on the current regulatory and political climate. Additional uncertainties include whether removal of radioactive contamination is necessary, and, if so, is performed prior to, or during, the treatment process. If the equipment remains contaminated after treatment for PCB removal, additional time must be allowed for disposal at an on-site, low-level-waste disposal facility (if available). Obtaining a TSCA permit for a solvent-wash facility requires a proof-of-process step, followed by obtaining construction and operating permits. If a vendor installs an already proven process, the first step could be eliminated; the permit process could possibly be reduced to less than a year. Again, there is significant uncertainty with that time frame. A vendor-selection process followed by design and a lengthy internal DOE/Energy Systems review and approval process could extend the process by one or more years. The only vendor estimate available was provided by SDMI, who estimated that project duration, including permitting, construction, and operation, would be 12 to 18 months. Even this optimistic estimate is significantly longer than the time required for Alternative 1.

8.0 PRELIMINARY ASSESSMENTS*

The following section briefly describes the types of assessments that may be needed to support the project. These include risk; safety, health, and fire; quality assurance; and compliance with NEPA.

8.1 PROJECT RISK

Energy Systems will perform a preliminary risk analysis to identify potential hazards, assess risks, and develop plans to mitigate unacceptable risks. Guidance for performing the risk analysis includes Energy Systems' *Potential Problem Analysis and Risk Mitigation (Draft)* (ref. 10). The following subsections discuss relative risks associated with each of the proposed alternatives.

8.1.1 Alternative 1: Off-Site Release as Nonradioactive Waste

This option poses minimal technical risks. Standard industrial hazards will be present, including the potential for slips, trips, falls, and being crushed by equipment or falling objects (i.e., mechanical hazard). The transformers may leak residual fluids during transport, thereby causing a spill. With appropriate documentation, use of this alternative will, for most of the transformers, meet all regulatory and legal requirements. Public-relations impacts on both DOE and Energy Systems are believed to be minimal.

From a legal standpoint, the risks of off-site release are many and complex. The risks involved in the off-site release of transformers to a site that does not have an NRC license is the potential legal liability if the materials are subsequently found to contain radioactive materials in excess of that allowed by either federal or state regulations. Several factors make this event possible. The Objective has a requirement of "no rad added" in bulk or volume. Because naturally occurring radioactivity is present in all things, meeting this requirement is extremely difficult to prove and allows the probability that despite best efforts and testing, material could be sent off site and later be determined to be radioactive. Another factor is that state and local regulations may impose more stringent requirements on radioactive levels than the DOE regulations. If these are not recognized by Energy Systems prior to sending materials off site, violations of regulations may occur. Another factor is the Atomic Energy Act requirement that only NRC-licensed sites may possess Special Nuclear Material. Since K-25 was a uranium enrichment facility, radioactivity at K-25 is likely from enriched material. Regulatory officials could use this as a basis for showing that Energy Systems has violated the law even though contamination levels may be extremely low.

Violations of environmental, safety, or health laws carry serious consequences for Energy Systems and for individuals involved with shipping and release of the materials, both in terms of civil liability and criminal liability. The transformers pose particular problems:

- The internals cannot be directly surveyed or analyzed.
- Much of the fin surface area is inaccessible.
- Paint may shield some of the surface contamination.

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*Note: Energy Systems' procedures (Ref. 8) give general guidance as to the content of a preliminary assessments section: EP-C-05, "Feasibility Study," pages 11 and 12 ("Preliminary Assessments"); and EP-C-06, "Conceptual Design Documentation," page 16 ("Assessments").

In order to minimize this risk, discussions with state regulators are required. On a recent contract negotiation involving PCB capacitors, provisions were placed in the contract that would require both the disposal company and the state regulatory officials in the disposal state to review and document that they essentially understand the nature of the material being received and approve of the materials being sent to their state. If the provisions of the contract are met, this would minimize the likelihood of future lawsuits against Energy Systems. For the capacitors, a similar tact is advised, and should be relatively straightforward as only surface contamination is involved, and there are no concerns about internal contamination, inaccessible areas to survey, or painted surfaces. However, these requirements have been difficult to attain and have been the sole reason that many of the contractors have refused to bid on the job. Since internal contamination assessments are involved in the transformer work, actual survey, analytical results, and sampling methodologies may have to be submitted to the state regulatory officials to seek to declare a transformer nonradioactive.

8.1.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

This option, if feasible, would pose the same risks as Alternative 1, with the additional risks of handling and shipping low-level radioactive material. Public-relations impacts will be greater than those for Alternative 1 due to negative perceptions of such waste by vendors, regulators, and the public.

As pointed out in Section 2.2.2, this option is not feasible at this time due to the apparent absence of a vendor with both an NRC license and a TSCA permit. If and when it becomes feasible, Alternative 2 will involve essentially all of the risks (both technical and legal) associated with Alternative 1 (Section 8.1.1).

8.1.3 Alternative 3: On-Site Treatment

On-site treatment poses construction risks for the facility and presents workers with additional opportunities for accidents involving industrial hazards. In addition, workers face potential exposure to solvents and solvent fumes along with exposure to PCBs.

8.2 SAFETY, HEALTH, AND FIRE

Energy Systems will perform a preliminary safety review to identify potential hazards and establish criteria for controlling each hazard. This review will include an evaluation of the need for additional analysis and documentation. The following subsections discuss relative safety, health, and fire concerns associated with each of the proposed alternatives.

8.2.1 Alternative 1: Off-Site Release as Nonradioactive Waste

Before nonradioactive waste is released off site, the only special considerations for the project are those routinely employed in lifting, hoisting, and rigging. Following release, no safety, fire, or health risks exist for Energy Systems.

8.2.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

This alternative poses no more risks than those presented by Alternative 1 with the exception of the minimal threat posed by low levels of radioactivity.

8.2.3 Alternative 3: On-Site Treatment

On-site treatment poses all the safety, health, and fire risks associated with a solvent or furnace facility. If a furnace or incinerator is constructed, provisions for fire protection will need to be made. Lifting, hoisting, and rigging considerations also come into play in this alternative. Various machines could also present physical hazards as a result of equipment failure or human error. Features to minimize the effects of accidents should be incorporated into the design, startup, operation, and maintenance of the facility.

8.3 QUALITY ASSURANCE

Quality Assurance (QA) planning will be performed by Energy Systems in accordance with *Site Project Management Organization Quality Assurance Program (SPMO-QAP)*, 19-92-0001/R0 (ref. 4). This provides criteria for the application of technical, managerial, and administrative controls to both projects and ongoing operations. Specific QA concerns are discussed in the following subsections.

8.3.1 Alternative 1: Off-Site Release as Nonradioactive Waste

Energy Systems must assure that: (1) appropriate S&A activities are planned and implemented (see Section 2.1.2); (2) Health Physics performs appropriate surveys and that these are properly documented; (3) manifesting is properly handled; and (4) transformer weights are accurate.

8.3.2 Alternative 2: Off-Site Release as PCB/Radioactive Waste

The only additional requirements beyond those for Alternative 1 are radioactive-waste manifesting.

8.3.3 Alternative 3: On-Site Treatment

On-site treatment facilities require a full bar-code system for tracking transformers and components. In addition, QA requirements for design, construction, operation, maintenance, and laboratory results must be observed.

8.4 NATIONAL ENVIRONMENTAL POLICY ACT

A NEPA review is required for all three of the alternatives under consideration (NEPA requirements are given in 10 CFR 1021). Under these regulations, actions may require either an Environmental Impact Statement (EIS) or an Environmental Assessment (EA), or they may be categorically excluded from further consideration. A Categorical Exclusion has been received by Energy Systems for off-site release of the transformers. Subpart D of the NEPA regulations specifies the treatment required for various classes of actions.

With the exception of incinerators, on-site treatment of PCB equipment (Alternative 3) is not singled out in the list of NEPA actions; therefore, an EA is needed to determine whether an EIS is required. Any facility constructed on site that includes an incinerator requires an EIS under 10 CFR 1021, Appendix to Subpart D, Item D12: Siting/construction/operation of incinerators.

9.0 RECOMMENDATIONS

This feasibility assessment recommends that DOE and/or Energy Systems use Alternative 1 where possible, because it is legally sound, technically feasible, cost-effective, and in accordance with both DOE and Energy Systems policies.

Implementation of this recommendation can be accomplished in the following ways (as shown in detail in ***Figures*** *7.1, 7.2*, and *7.3*):

1. Perform additional sampling and analysis on dielectric fluids from both the K-25 transformers and selected KUB and/or TVA transformers to document conclusively the nature and extent of radioactive contamination. The resulting analyses should then be statistically compared.

2. For transformers originating outside an RMMA (none of the K-25 transformers fall into this category), implement Alternative 1:

   - certify for otf-site shipment to a TSCA-licensed facility for treatment, disposal, and recycling (if drained fluids were ≥500 ppm PCB); or

   - manage as nonradioactive waste (if drained fluids were <500 ppm PCB) in accordance with Standard ESS-EP-125.

3. For transformers originating in an RMMA, verify that both the interior and the exterior are not radioactively contaminated (see Sections 2.1.2, 3.4, 4.1, and 4.2). For nonradioactive transformers (expected to be in the majority), implement Alternative 1 (see Recommendation 2).

4. For radioactive transformers whose drained fluids were <500 ppm PCB, also implement Alternative 1 (i.e., certify for off-site shipment to an NRC-licensed treatment, disposal, and recycling facility).

5. For radioactive transformers whose drained fluids were ≥500 ppm PCB, implement either Alternative 2 or Alternative 3:

   - certify for off-site shipment to a TSCA- and NRC-licensed facility for treatment, disposal, and recycling (this alternative is not feasible because no such facility is in existence); or

   - perform on-site treatment as necessary to reduce the level of contamination; certify for off-site shipment to a TSCA-licensed facility for treatment, disposal, and recycling.

10.0 REFERENCES

1. *Performance Objective for Certification of Nonradioactive Hazardous Waste*, DOE Office of Environmental Restoration and Waste Management - Office of Waste Operations (EM-30), November 15, 1991.

2. Martin Marietta Energy Systems, Inc., *Radiological Control Manual*, K/HS-410, December 1992.

3. Nolan, S., *Facsimile Transmission of Transformer Oil Analytical Results and Scatter Charts*, August 31, 1993.

4. Martin Marietta Energy Systems, Inc., *Site Project Management Organization Quality Assurance Program (SPMO-QAP)*, 19-92-0001/R0, May 28, 1992.

5. John A. Moore, U.S. Environmental Protection Agency, Washington, D.C., letter to Toni K. Allen, Law Offices of Piper and Marbury, Washington, D.C., September 9, 1986.

6. U.S. Nuclear Regulatory Commission, *Guideline for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, Division of Fuel Cycle and Material Safety, Washington, D.C., July 1982.

7. *Operational Evaluation of the Offsite Release Policy (Draft)*, provided by Energy Systems, no date.

8. Martin Marietta Energy Systems, Inc., *Management of Polychlorinated Biphenyls (PCBs)*, Standard ESS-EP-125, Revision 1, July 28, 1992.

9. Martin Marietta Energy Systems, Inc., "Engineering Design," Section C, *Engineering Procedures Manual*.

10. Martin Marietta Energy Systems, Inc., *Potential Problem Analysis and Risk Mitigation (Draft)*, August 9, 1993.